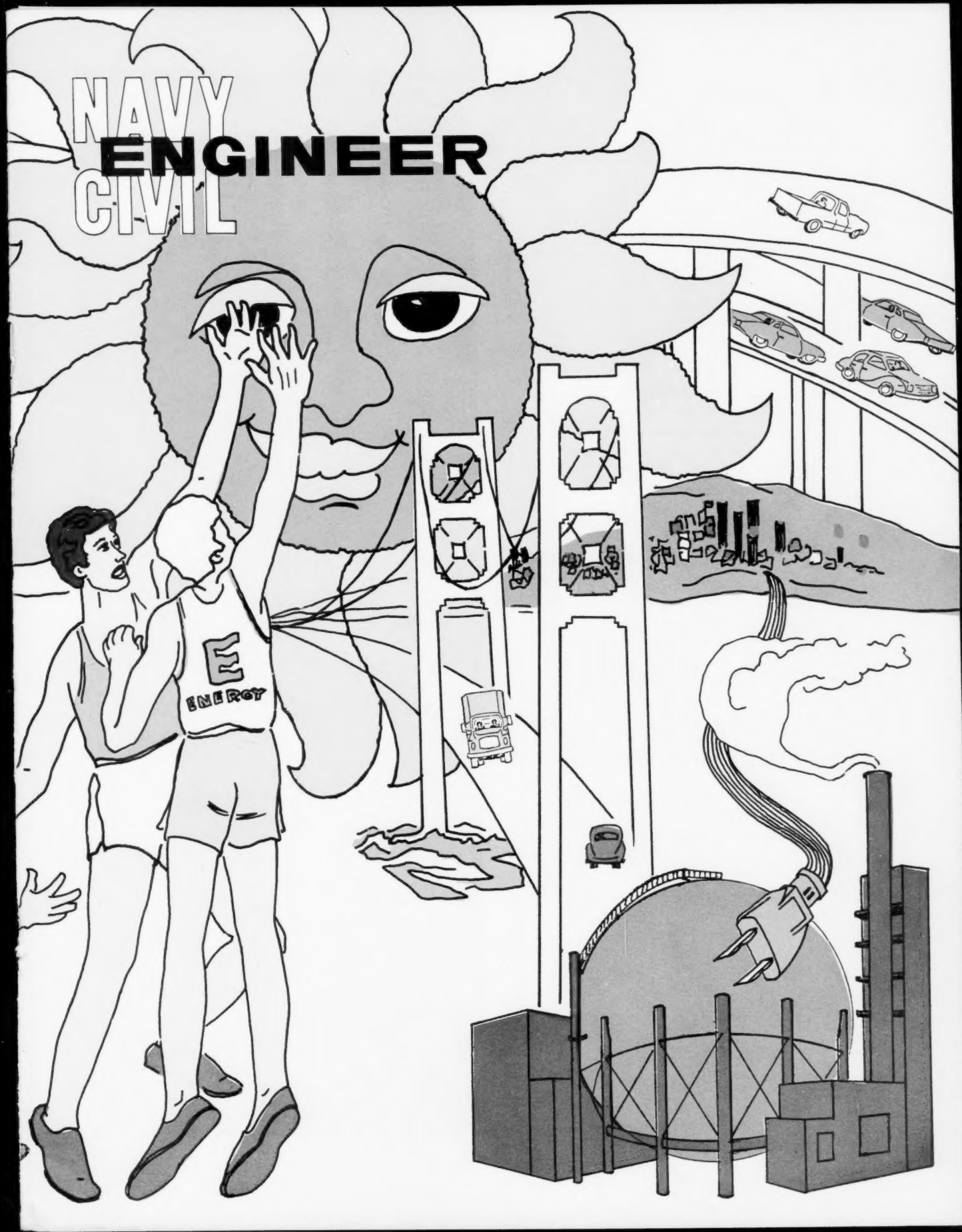
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ENERGY MATTERS, today's national concern, are covered throughout this edition. A special portfolio from Headquarters begins on page 6.

BIG BITE of a dredge demonstrates just one aspect of the multi-faceted responsibilities of a Navy Public Works Center described on page 44.

A New Harbor

Naval Home to Move From

Since 1827 the Naval Home has occupied historic Philadelphia quarters.

In the midst of a torrential downpour in Gulfport, Miss., the Governor of the Naval Home lowered a signal flag and, in time-honored Navy fashion, ordered the start of construction for the new Home. The construction will provide replacement facilities for the present Naval Home located in Philadelphia, an institution time-honored in its own right.

The Naval Home establishment dates back to 1796 when contributions from sea servicemen were solicited to establish a retirement fund for "disabled and decrepit Navy officers, seamen, and marines."

Interestingly, in addition to the contributions, funds from the sale of prizes of war were also used to form the Navy Pension Fund. This fund, held in trust by the government, totaled more than $200,000 in 1827 when the cornerstone for the Naval Asylum (as it was then known) was laid in Philadelphia.

The keynote speaker on that day was Commodore William Bainbridge, one of the nation's earliest naval heroes. The distinguished officer said that a home was being established: *"for the faithful tar who has been either worn out or maimed in fighting the battles of his country. A comfortable harbor will be secured where he may safely moor and ride out the ebb of life, free from the cares and storms by which he has been previously surrounded. He will here cheerfully and proudly live with his own messmates, with the companions of his former sports, toils, and dangers, and where they will animate each other recounting the pleasures which they enjoyed, the perils which they escaped, and the battles which they fought . . ."*

Since then, the U.S. Naval Home, as it was renamed in 1889, has been a comfortable home for elderly and disabled Navy and Marine Corps veterans. An historical side note is the fact that the Naval Home was the site of the original Navy School which began instruction for midshipmen in 1839. The school moved to Annapolis in 1845 where it then became the United States Naval Academy.

Among those who may be admitted to the Naval Home are Navy and Marine Corps veterans, officer and enlisted, men and women, who are unable to support themselves by manual labor. Retired or pensioned individuals make up nearly all of the residents, the remainder being veterans of wartime service who have become physically incapacitated in later years.

The Naval Home is a retirement residence where an applicant, once accepted, is welcome to remain the rest of his life, or if he desires, may leave whenever he chooses. At present, there are nearly 300 men and women at the Philadelphia facility. The men's average age is 72 and the women's 74. The oldest man is 97 and the oldest woman 83.

The decision to move the Naval Home came after extensive studies showed it uneconomical to further upgrade the Philadelphia facilities, many of which date back to the 19th century. The main buildings, for example, were constructed in 1833 and 1845 and feature solid masonry walls 18 to 36 inches thick and with ceiling heights 12-14 feet.

Resident rooms are small, averaging under 70 square feet, and barely provide enough room for a bed, wardrobe, and desk. Through the years, various conveniences have been added to the buildings including electricity, central heating, and sanitary facilities, but complete modernization is not economically possible. The relocation studies reviewed possible sites in Texas, New York, Florida, and Mississippi before finally settling on the Gulfport location.

The new facility under construction will be an impressive

For Old Salts

Philadelphia to Gulfport

By LCDR ROBERT BELL, CEC, USN
Resident Officer In Charge of Construction

addition to the Gulf Coast and will be the highest structure in the area. It is located on a 35-acre beach front site dotted with huge old oak and magnolia trees, and will offer most residents of the Naval Home a view of the waters of Mississippi Sound.

Featured will be a main building with two connected, ten-story residential towers, along with single story attached support facilities. In addition, the new complex will ultimately include a chapel, hobby shop, laundry, maintenance shop, greenhouse, swimming pool, summer pavilion, pedestrian overpass, and five sets of family quarters for the Governor of the Home and key members of his staff (the chapel, hobby shop, and laundry building have been completed).

Extensive landscaping of the entire site is included in the project to complement the natural features and existing foliage. The various buildings were situated to make best use of these assets and minimize site clearing.

The main building will contain more than 300,000 square feet and will house 600 residents. Included in the main building on the ground floor will be reception areas, administration offices, visitors reception center, a theater, a bank, post office, recreational areas including shuffleboard and bowling, a library, food service facilities, a Navy exchange cafeteria, and retail store. Miscellaneous facilities include a radio and TV repair shop, shoe repair shop, barber and beauty shops, and tailor and valet shops.

A 60-bed extended care medical unit with outpatient clinic, dental clinic, physical therapy, x-ray laboratory, pharmacy, examination and treatment areas, including normal hospital facilities, will be attached but separate from the main facility.

The twin ten-story towers will contain spacious individual bedrooms with private half baths and central showers. In the central lobby of each tower section will be game rooms and lounges.

The first floor of the building is a conventional slab-on-grade brick veneer structure with steel columns; the twin tower section are pile supported steel frame structures. The exterior of the tower sections is innovative in design and features floor to ceiling anodized aluminum curtain walls with bronzed glass, precast concrete panels, and floor to ceiling precast brick panels that will be erected and attached to the structure in the same manner as the curtain walls and precast concrete panels.

The complex was designed by John L. Turner and Associates, Jackson, Miss., and is being constructed by Dyson Construction Company, Pensacola, Fla., with an anticipated completion date during the summer of 1976.

The design and construction contracts were awarded by the Southern Division, Naval Facilities Engineering Command. The author is the resident officer in charge of construction, with Lou Hunter as resident engineer and Jesse Grantham as the senior Navy inspector.

Scheduled for mid-1976 occupancy the Naval Home's new structure will be a striking edifice on Mississippi's Gulf Coast.

Rear Adm. Clyde J. Van Arsdall, Jr. (right), Naval Home governor, and Lt. Cmdr. Robert Bell face a squall with amusement as the admiral lowers a pennant to signal the start of construction of the new Naval Home at Gulfport, Miss. The facility is scheduled for completion during the first part of 1976.

The Navy's goal for energy conservation is a 15% reduction below the consumption level of FY '73. This objective is consistent with recent White House direction to all Federal agencies and services. While this goal is directly applicable to military personnel and civilians employed by the Navy, contractors should also be encouraged to make energy savings.

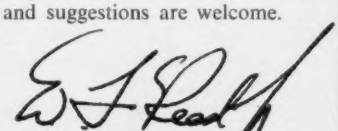
The role of the Naval Facilities Engineering Command in energy conservation is an essential part of the Navy's overall program. During this past year, we have seen new emphasis in all NAVFAC's programs in planning, research design, construction, operation and maintenance for Navy facilities.

A highly visible effort to date has been providing additional engineering assistance to shore activities to develop and implement their individual conservation programs and contingency plans. Correction of facility deficiencies to reduce energy consumption is the next fertile area for our efforts.

Field efforts to identify and program high pay-off energy conservation projects have gained considerable support at the DOD and OMB levels and we expect strong investment programs in FY '76 and FY '77.

Despite effective conservation, fuel costs and inflation are driving the cost of utilities out of sight. Particularly hard hit is family housing. Strong leadership, efficient management of utilities, and the application of sound energy engineering are receiving increasing support.

The articles compiled in this issue concerning NAVFAC programs in the energy area represent only a sampling of the high interest items presently underway at the Headquarters level. I am sure you will find them of interest. Your comments, ideas, and suggestions are welcome.



W. F. REED, JR.
Captain, CEC, USN
Deputy Commander for
Facilities Management

Fuel From Waste

Until recently, American cities have relied with confidence on relatively cheap fossil fuel for power and on nearby vacant land for solid waste disposal.

Today, a different picture has emerged.

Locating and financing non-polluting fossil fuels and non-controversial landfill areas has become the number one headache of our cities. It was a similar situation of expensive fuels and unavailable land which encouraged European cities after WW II to use municipal solid waste as a boiler fuel supplement. It made sense economically and aesthetically to them, and it is beginning to do so for us.

The combustible portion of solid waste — upwards of 70% of the total weight — can be used as a supplement to or can completely replace fossil fuels in existing or newly designed boilers. As the heat content in a pound of this waste is in the 7000 BTU range, each ton burned as fuel saves the Navy a barrel and a half of oil. Additionally, the low sulfur content of solid waste makes it less of an air pollutant than most coal and fuel oils. Some new boilers such as the Navy-built waste fuel, waterwall units at the Public Works Center, Norfolk, and Naval Shipyard Portsmouth, Va., can burn unprocessed waste direct from garbage trucks. Modifying existing boilers, however, is the less expensive and more immediate approach to using waste-as-fuel and thereby easing both energy supply and waste disposal problems.

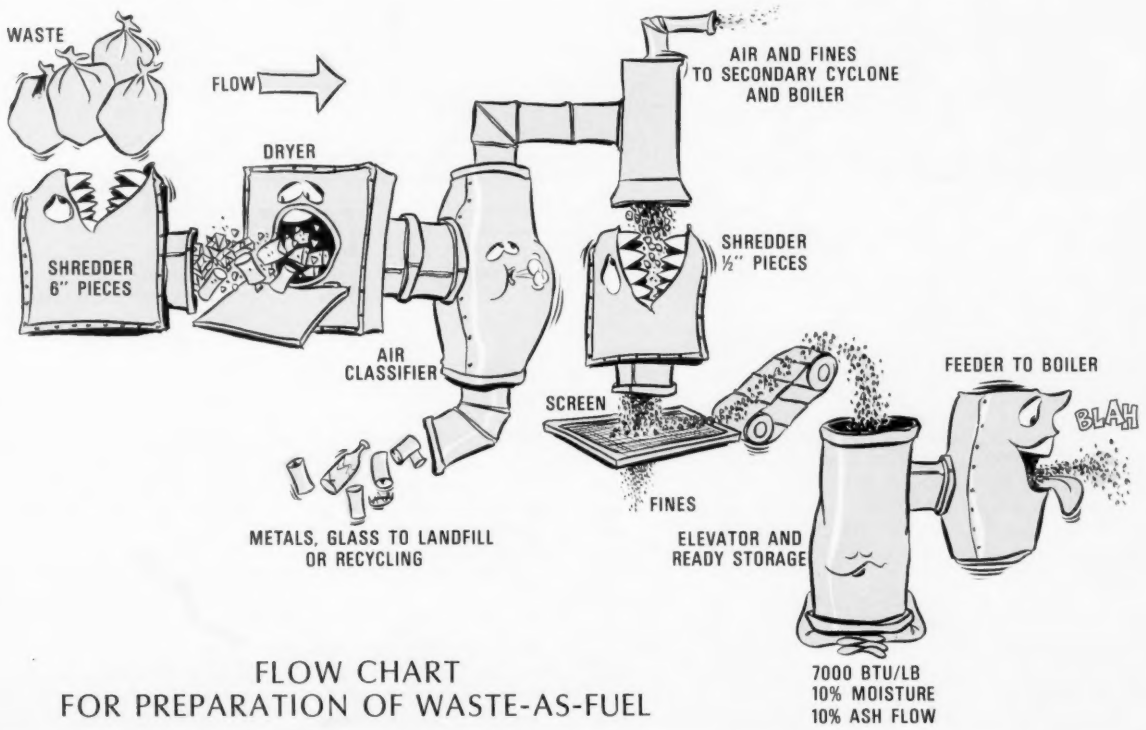
To use solid waste fuel, the boilers must have both bottom ash handling and fly ash removal capabilities. The conversion is not overly complicated as all coal-fired boilers and most boilers retrofitted to burn oil or gas have this potential capability. In addition, the solid waste must be prepared by shredding or milling and the heavy non-combustibles separated out. Shredding and drying (to 10% moisture) eliminate rodent, decomposition, and odor problems in storage. The preparation of this waste-as-fuel for sale has become attractive to private enterprise and a number of large firms are already in operation.

For the Navy's proposed waste fired boilers at the Naval Shipyard, Philadelphia, NAVFAC will review the capabilities of over twenty firms to provide: responsibility for disposal of station solid waste; necessary modifications to existing boiler systems; and adequate supplies of prepared waste-as-fuel.

Though solid waste fuel from outside the Philadelphia shipyard must be included to meet the large boiler fuel requirements, station solid waste fuel alone will save the shipyard 32,000 barrels of oil each year.

NAVFAC has other studies underway on the feasibility of waste-as-fuel at Charleston, S.C., Mare Island, Calif., Puget Sound, Wash., Patuxent River, Md., and Quantico, Va. Like Philadelphia, these activities are faced with remote or short lived waste landfill areas and with costly fossil fuels. The waste-as-fuel alternative can become both environmentally preferable and economical for them.

The potential for energy production and materials recovery from Navy solid waste becomes greater with a passing day. Through current studies of solid waste management at shore installations, NAVFAC intends to support the beneficial recovery of this neglected resource.



FLOW CHART
FOR PREPARATION OF WASTE-AS-FUEL

NAVY EXPLORES ALTERNATIVE ENERGY SOURCES

With current emphasis on energy conservation and awareness of increasing costs of energy, interest has been widely expressed in the possible use of local energy sources to augment or replace dependence on fossil fuels.

These "local sources" include solar energy, either directly — such as solar panels for heating and cooling, photovoltaics (the familiar space solar cells), photothermal (the concentration of the sun's heat on a source for heating) — or indirectly — such as wind, ocean temperature differences or bio-conversion (plant growth for fuel use); as well as geothermal energy, tidal action and wave action.

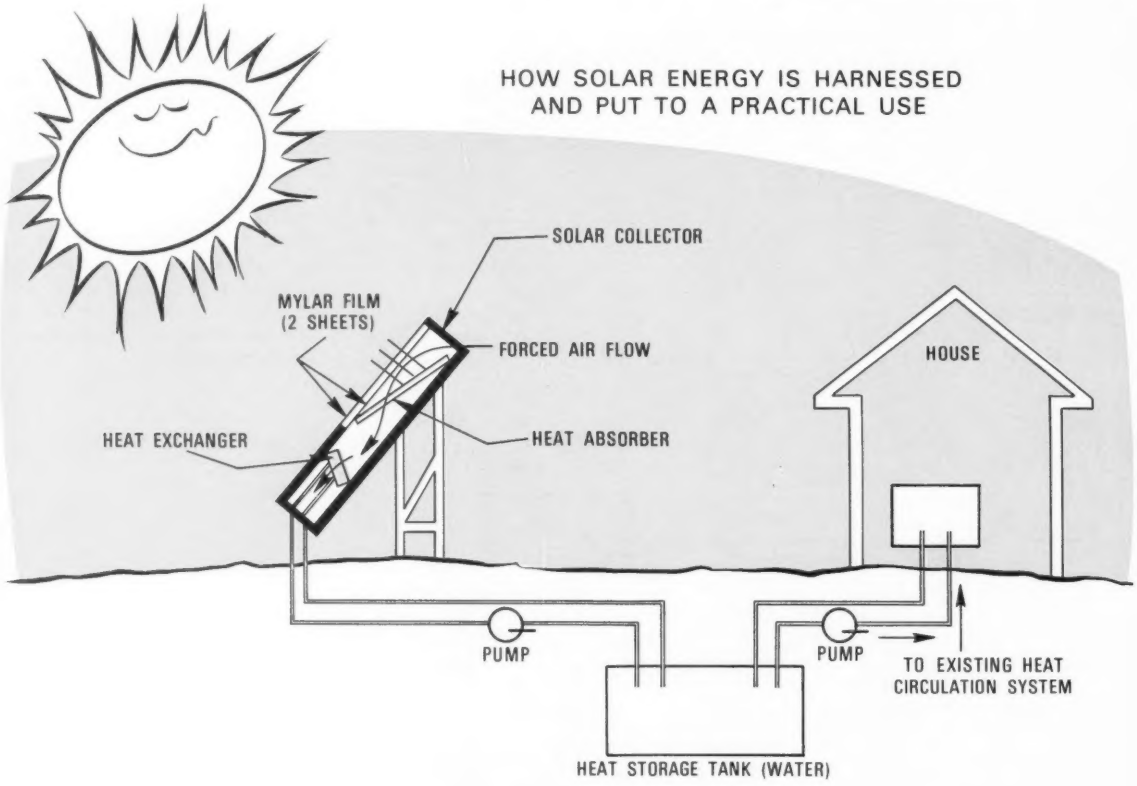
In each of these areas, except for tidal and wave energy, an agency of the Federal government other than the Department of Defense (DOD) has been designated the lead responsibility for development of the concept. In the case of tidal and wave energy, these potentials were considered to be of small import since the cost to obtain significant quantities of energy from them is too great for the benefit obtained.

For the solar program alone, $50 million have been earmarked for FY75 to these other agencies for development of the potential resource. The primary problem is bringing the cost of these alternatives in line with other and more conventional energy sources.

As cost of fossil fuel rises, these alternatives look more attractive. The Navy, through representatives on interagency energy panels, is tracking the national programs for advances in technologies and cost breakthroughs which can then be applied to specific Navy needs.

The Navy is taking active part in the development of local energy sources. At the Naval Ammunition Depot, Hawthorne, Nev., two solar heated homes have been "on line" since November, 1973, and officials there have proposed to the National Science Foundation to do research in solar water heating as part of the national program.

At the Naval Weapons Center, China Lake, work is about to begin exploring the Coso geothermal area to determine if there is sufficient activity to warrant development. At the Naval Ordnance Laboratory, used helicopter blades are being investigated for possible use in wind machines with the output being used to resistance heat a building.



The Civil Engineering Laboratory has an active program for FY 75 looking into what is available in the local source energy market and search out possible economic applications.

The Navy is both keeping an eye on and participating in the development of what many think will be a sizable energy producer by the year 2000 — local energy sources.

POWER COSTS

The energy shortage has resulted in higher costs of purchased utility services. Despite reduction in usage, commercial utilities for the Navy and Marine Corps have increased $30,000,000 in FY 74 for an all time high total cost of $200,000,000.

A great share of the cost has been immediate and direct through fuel adjustment clauses in existing contracts for utility services which have increased in range from 18% to 155%.

Another factor is inflation plus the increase in interest costs paid for financing plant expansion. These increases are sought by utility companies through rate increases to be approved by regulatory agencies, e.g., the electric utilities have obtained increases of 10% during the past year, over and above that obtained from fuel adjustment clauses.

The annual expenditure of sums of money of this magnitude demands close scrutiny. Any economies realized could become available for other purposes, such as maintenance and repair, for which there is just never enough money appropriated.

Since the utility bills must be paid and the money comes first from the operations and maintenance budget, any cost prevention represents real savings. This is particularly true in FY 75 and FY 76 due to the dramatic increases in the cost of fossil fuels. These increases will not be fully provided for in the budgets of the aforementioned years. Concern with obtaining the service furnished at the lowest possible rate, conservation and the judicious use of service will reflect in a lower utility bill. Experience tells us that we can achieve substantial and significant savings.

NAVFAC has the responsibility of providing these savings, negotiating the rates and charges, and administering the contracts to assure that the Navy continues to receive service at the lowest rate. Timely periodic technical review will avoid excess charges when there are increased commercial requirements, changes in load characteristics or a change in the supplier tariff. Timeliness is important since under present utility law and practice the supplier is not obligated to keep the customer on the best rate.

NAVFAC also has the responsibility of appearing at rate proceedings of state or federal regulatory agencies to protect the Navy's interest.

Four utility rate engineers have been employed to meet the additional work load resulting from the increasing number of rate increase applications filed by the utility companies.

Current Energy Data

The Defense Energy Information System (DEIS) was developed as a result of the restricted supply of oil and power. Spot shortages were occurring and there was an increasing uncertainty over future energy supplies. It was apparent that wide-reaching energy problems would require speedy and comprehensive solutions.

Information on consumption rates, present and projected inventories, storage locations and capacities, distribution systems, and costs for each type of energy use was needed for management decisions. The Defense Supply Agency (DSA) was assigned the responsibility for developing an automated energy information system to meet management needs. The most critical problem involved petroleum supplies and during December 1973 a weekly petroleum report, DEIS I, was established. This report provides information on inventories, weekly consumption and receipts.

The following month, the system was expanded to include utilities' energy consumption. Designated as DEIS II, the report contains monthly consumption of purchased electricity, fuel oil, natural gas, propane/LPG, coal and commercially purchased steam and hot water.

The mechanics of DEIS require operating units and activities to forward data directly to DSA. The messages are in a format which permits automatic punching of ADP cards. Output information is provided to both DOD and the individual services.

In addition to providing reliable and comprehensive information on DOD energy resources, DEIS provides a means of measuring the success of conservation programs. Monthly FY73 consumption data is included along with the current monthly consumption figures for comparison purposes.

One of the shortcomings in DEIS II was its inability to separate the Navy funded portion at activities which also provided reimbursable energy support to the other services and Federal agencies. The system is being expanded to include such capability.

The Total Energy System

The Office of the Secretary of Defense recently issued new criteria for a total energy system to assure proper consideration of these systems in all large new facilities and in major rehab projects.

These energy considerations apply to projects beginning in FY75 and with new projects from three points of views: TE (total energy) systems, selective energy systems, and large built-up heat pump systems.

Since the use of a total energy system depends on a reasonable balance between power generation and use of waste heat for air conditioning, heating and domestic hot water, it is vital that the design consider all energy conservation and recovery methods as well as chilled and hot water storage. If balance is a problem, design should give consideration to supplying adjacent buildings with power, heat, or chilled water on a continuing or off-peak basis.

The new criteria has been distributed to the EFDs, and NAVFAC has selected specific projects in the FY75 and FY76 Programs for which feasibility studies are to be made as part of the design development. Example projects are the Demilitarization Facility Complex at Hawthorne the Hospital-University Complex at Bethesda, the Hospital Complexes at San Diego and Bremerton, the Admin Complex at New Orleans, and the Fleet Combat Support Center at Pearl Harbor.

In accordance with the criteria, where TE is found to be economically feasible, such system will be required. In selecting A/Es for these projects, due consideration is given to qualifications experience in performing TE studies and designing TE systems.

Should TE systems be provided as part of a Navy facility, intensive training programs will be necessary to insure that operating and maintenance personnel are fully qualified to satisfactorily operate and maintain the highly complex equipment system involved.

'Energetic' Research at CEL

The Civil Engineering Laboratory (CEL), the executing arm of NAVFAC's RDT&E Program, is becoming increasingly involved in the Navy's energy problems. Energy programs, conservation and modification, will receive emphasis during the current fiscal year.

The work is quite diversified and ranges from the investigation of unique insulation applications to the determination of insolation (the amount of sun arriving at a given location) measurement techniques, and almost everything in between.

The primary thrust of the CEL energy program is keeping track of what is occurring in other Federal agencies and in industry, and to apply emerging technologies to specific Navy needs. The significant problem of transferring these technologies into the Navy facilities system falls heavily on CEL.

Under the manifest of "reduction of energy usage ashore", CEL is investigating infrared analysis of energy losses in buildings, evaluating new energy standards in new and existing buildings, developing a remote monitor to determine the efficiency of small boilers, investigating total energy systems and their applications to the Navy, and evaluating the possibility of running auxiliary blowers, etc., for steam systems from exhaust steam rather than electricity.

Within a category of "alternatives to conventional use of petroleum," CEL is aiding in the determination of criteria for the use of solid waste as an energy source for bases. The program will provide guidelines to Naval activities for determining what is the most efficient use of their solid waste. This study includes a look at some of the innovative fuel-burning techniques that reduce consumption and increase efficiency, improvement of coal burning systems, an evaluation of synthetic lubricants and fuels and their effect on Navy equipment, and the possibility of recovering waste lubricants now discarded.

Another task CEL is participating in are "systems using local energy sources", which involves collecting insolation and wind data from the national weather services and local Navy bases to determine where new energy sources can provide significant portions of the energy demand. A wind generator project using discarded helicopter blades is also being funded, together with work in heat pumps, solar energy for hot water and space heating, and energy storage systems.

To increase the flow of technical information, the Fiscal Year '75 R&D program includes two projects of a technology-transfer nature: the hiring of two full-time liaison personnel who will travel to the EFDs and some of their activities with new innovations in the energy-conservation field, and an addition to the current RDT&E liaison program at the Civil Engineering Laboratory where energy conservation measures and new equipment information will be added to the RAP BRIEFS now published and sent to activities. The latter program will also include, as a part of the existing telephone "hot line", answers to energy questions which can be called directly to the CEL for quick response at no cost to the caller. In the past few years, use of this service has increased dramatically, and it is expected that such an information system will aid immeasurably in the transfer of technology. The service is available 24 hours a day by calling Autovon 360-4070 or commercial (805) 982-4070.

Outside the Navy energy R&D program, CEL has submitted three proposals to the National Science Foundation in the area of underwater concrete hulls for large ocean thermal difference power plants, and a reimbursable agreement is being considered for the purpose of having CEL personnel participate in the evaluation of proposals to NSF in areas of their expertise.

CEL is now involved in the Navy energy program in considerable scope and as this involvement continues, it is anticipated that the Naval shore facilities community will reap significant benefits.

COMPUTORS ANALYZE POWER DISTRIBUTION SYSTEMS

Utilities engineers at engineering field divisions are currently using a time-sharing computer to analyse utility distribution systems. The computer enables an engineer to conduct in-depth analyses to solve problems on utility system efficiency, capacity, operation, maintenance and determine the optimum timing, size and location of system improvements.

Electric power distribution systems have been analyzed by NAVFAC Headquarters since 1958. The recent adoption of time-sharing digital computers has given Engineering Field Division engineers direct access into this program. In 1973 the analysis of electric power systems reduced the military construction cost of planned improvements by $8,000,000 through improved definition of requirements and tailoring system improvements to meet these requirements efficiently and reliably. These power system analyses additionally identified many safety and operating problems which were immediately corrected and also reduced distribution system energy losses by over $200,000 per year.

A computer program to analyze the energy requirements of a building is anticipated to be available to Engineering Field Division utilities and design engineers in 1975. This new capability will assist engineers to make recommendations to modify an existing building's operation, HVAC system or construction to save energy.

A network analysis program for steam distribution systems is currently being developed and should be available to Engineering Field Division utilities engineers in the spring of 1975. Thereafter the program will be enhanced to include network analysis of compressed air, natural gas and water distribution systems.

By the fall of 1975, it is anticipated that utility engineers will have a complete series of computer programs to analyze all major utility distribution. It is anticipated that analysis of the mechanical utility distribution systems will achieve even greater savings than are being achieved through the current analysis of electric systems.

Super Tankers To Military Ports?

In its report on the effects the energy situation would have on the national defense establishment, the Defense Energy Task Force included a recommendation that "the services should prepare programs for modernizing strategic, high usage military petroleum terminals to accomodate tankers up to 80,000 tons."

Such a recommendation opens avenues of discussion and thought to those who might be faced with preparing such a terminal modernization program.

In 1950 world bulk tonnage was moving in 16,000 ton tankers and the largest ocean bulk carrier in operation was 24,500 tons. As recently as 1966 there was only one ship in the world over 200,000 tons. Now, in 1974, there are more than 800 ships over 100,000 tons and over 400 in excess of 200,000 tons.

By 1980 the 200,000-300,000 ton tanker will become the standard workhorse of large scale world bulk cargo movements. To operate at full load draft these mammoth tankers require water depths from 60 to 90 feet. The present U.S. port system, particularly on the North Atlantic coast, is wholly inadequate to accommodate these large ships. With a few exceptions on the West Coast, existing channel depths of 35 to 40 feet at the majority of U.S. ports severely limit vessel sizes to about 80,000 tons.

There are, however, no military oil terminals which will now accommodate the 80,000 ton ships and ships of this size will eventually become a common size carrier. These carriers will be handling not only crude petroleum on the way to a refinery, but also refined products to be stored in military fuel terminals. Hence, the recommendation to determine the cost of modernizing the terminals to take ships of this size.

Action on this recommendation will be passed to DSA (Defense Supply Agency) and the services to prepare a plan defining the scope and budgeting required to modernize military terminals to accommodate the larger tankers. The study will cover the full range of facilities including piers, channels, pipe lines and storage necessary to receive and discharge fuel.

Several basic questions come to mind:

What is a high usage terminal?

How many are there and where?

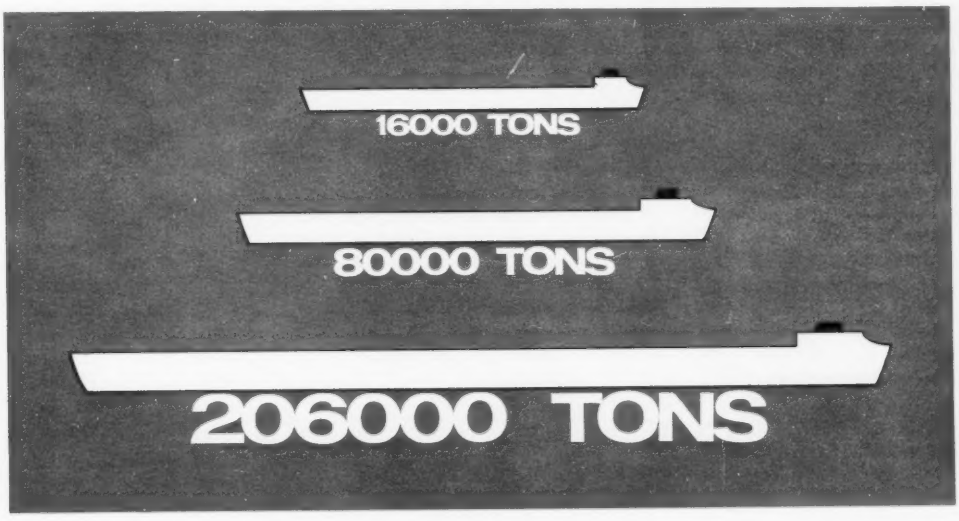
What are the navigation requirements for an 80,000 DWT tanker, i.e. —draft, length, beam, etc.?

The Defense Fuel Supply Center has furnished the basic information on the first two questions. Throughout the world there are approximately 30 locations which meet the high usage criteria, and for all practical purposes, none of them can accommodate an 80,000 ton tanker. These ships draw about 50 feet of water, have a length of over 700 feet, and a beam of about 120 feet.

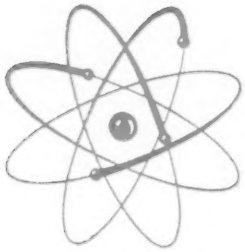
Engineering studies will be required to determine alternative methods and costs to modernize each of the terminals; a quantitative/qualitative description of the operational, logistic and technical factors controlling such modernization; the environmental impact of each project with a determination of the required monitoring of proposed dredging and spoil disposal.

NAVFAC effort will include screening of sites, determination of hydrographic characteristics of selected sites, evaluation of terminal configurations and capacity, determination of ship characteristics and capabilities, and actual site selection.

The Navy Hydrographer will assist by providing information on existing channel depths and required widths, plus information on navigational problems and the necessary aids.



what about nuclear power?



This past summer the Assistant Secretary of Defense (Installations and Logistics) directed that a tri-service plan for re-evaluation of nuclear power in the shore establishment be prepared and presented to the Defense Energy Policy Council. This direction was prompted by the energy situation and the successful operational history of small nuclear plants within the Department of Defense.

The plan envisions a tri-service committee which will look at service energy requirements at installations; investigate the technical feasibility of meeting these loads by use of nuclear reactors; look at the economics of nuclear versus conventional plants; and investigate the benefits which might be gained through the use of nuclear plants.

It is intended not as a research and development effort but rather to the use of a plant which may be commercially available. An example might be the consolidated nuclear steam generator presently under development for the Maritime Administration for use in large tankers. This plant is also being evaluated by large process steam users and by some developing nations.

The study will take one year to complete with quarterly status reports submitted to the Defense Energy Policy Council. Each Armed Service will have a full-time member with additional support provided by the services or by contract.

Another investigation in the possible use of nuclear power is an effort by NAVFAC to determine the feasibility of jointly providing capital with a utility firm to build a large nuclear power plant. The intent here is that defense installations then would get guaranteed quantities of electricity at a certain pre-determined rate based on the utilities cost for operating and maintaining the nuclear plant purchased with joint capital.

Savings/investment ratios and utility company interest are key issues. A number of points need further investigation. These points are the basis of continued discussion between the utilities and NAVFAC.

Energy Investment, A 5 Year Plan

In response to Presidential direction of a National Energy Conservation effort, the Secretary of Defense issued a directive to all Armed Services requesting them to reduce energy consumption by 15% and to develop a comprehensive five year energy reduction program.

The Chief of Naval Operations requested Major Claimants to submit a listing of all known "high payback" energy savings facilities projects that could be accomplished through Fiscal Year 1976 and submit a follow-on program for four additional years.

Approximately 1,000 projects were submitted. With MCON funding levels already severely constrained, a new standard had to be established for screening and ranking the projects.

Initially projects were ranked according to their energy savings compared to the dollar investment. Program funding levels had been estimated by use of field sampling, design analysis, and statistical projections. Approximately 70 Navy and Marine Corps projects were finally selected for Military Construction with additional work on approximately 15,000 family housing units. The total program was initially submitted at $59 million.

The Navy program projected an annual savings of roughly one million barrel equivalents of energy and a simple amortization of 3.3 years. Projects included insulation, storm windows, energy monitoring and controls, lighting conversions, power factor correction, utilities system modernization, boiler plant economizers, waste heat boilers, new condensate return systems, and a variety of similar energy improvements. Preparation of construction plans is now underway on these projects.

For FY77, a similar program has been submitted totaling $86.8 million with again a simple payback of less than 5 years.

OSD ground rules for the 5 year Energy Conservation Investment Program relate economics and energy. Projects must have an early payback and must reduce energy consumption by 15%. Retrofit of existing facilities along with emphasis on modernization and improvement take precedence over repair, and the first increment of the program is restricted to the 50 states.

Inclusion of other aspects of the facilities energy problem such as fuel conversion, increased fuel storage, overseas facilities, new construction, and total energy plants is still under consideration.

As a new program in a severely constrained budget arena, new investments for energy conservation have been given a high priority. Several excellent ideas and projects have been developed in a short period of time. Candidate projects are still needed for out-year program and are welcome at NAVFAC. EFDs as a part of their energy surveys are also on the lookout for high pay-back energy conservation projects.

The Navy's Regional Energy Planning Study

The Department of Defense and more specifically, the Navy Department, is in a unique position to make major contributions to the national energy effort.

A naval complex is in essence a microcosm of the energy-consuming public in that elements of the residential, commercial, industrial and transportation sectors are represented. And at many complexes, the Navy is also a producer of energy, thus providing a great deal of flexibility and diversity of options in coping with the energy production and distribution problems.

Historically, planning of naval bases has never been subjected to quantified economic analysis to establish whether people and material flow, land utilization or energy cost is being optimized. Moreover, little consideration has been given to the possibility that a solution to a local facility problem may exacerbate a regional problem.

Inasmuch as military lands can no longer be considered a free economic "good" and energy in every form is becoming more costly, facilities can no longer be designed and sited on a one-by-one basis. It is imperative that operationally related and environmentally compatible facilities be clustered, high density facility designs be undertaken and support facilities be integrated.

Feasible master planning alternatives must be evaluated in terms of total system life-cycle costs as well as initial investment costs alone. This necessitates that with respect to energy requirements the make-or-buy option be examined since a larger array of make options became or are becoming technologically and economically feasible. For example, total energy systems (TE) provide the advantage of utilizing heat that other power generating systems dissipate through the cooling system. A wide choice in size and fuel form (including solid waste) make TE an attractive make option.

The Navy needs to identify the optimum energy posture for the short-range (to 1985) and mid-range (1985-2000) periods in the light of projected rates of technological advances. Each option or alternative (or mix of alternatives) that would enhance the Navy's energy posture needs to be economically assessed in terms of life cycle costs and feasibility based on the level of funding support. The Regional Energy Planning Study currently underway in NAVFAC's Systems Analysts Analysis Division seeks to develop a solution oriented planning technique that is demonstrably feasible, economically beneficial and of general applicability for use in preparing "energy annexes" to both activity and regional master plans. As soon as the technique is completely developed, a pilot study will be conducted to test out the analytical concepts and techniques and to identify the depth of data necessary for such an analysis.

The basic frame of reference will be projections of the Navy's demand for various forms of energy. Coupled with this, will be the supply projections and the unit cost of each energy form to the consumer. Arrayed chronologically on the planning horizon will be the various buy/produce time-phased options or alternatives open to the Navy. Using the status quo as the base case, the time-phasing of energy alternatives can be evaluated from an economic point of view.

Plans are to have the analytical method computerized for ease of operation. The system will be designed to allow parameters to be readily changed, to provide flexibility in area coverage and operational application. In addition, the system will be modular in concept (open-ended) to allow structural modification to the system. Early 1975 is the target date for computer model demonstration.

An Enormous Potential

Reclaiming Oily Wastes

The Navy's environmental protection program is providing an impetus for collecting and concentrating oily wastes at selected shore activities. The Federal Water Pollution Control Act of 1970 prohibits discharging unwanted oily waste material directly on land or into inland waters or the sea. All oily wastes must now be properly handled and disposed of in a legally acceptable manner.

The Navy's oily waste material is generated both on shore and aboard ship. However, the physical and chemical nature of the waste material as well as required pretreatment and recycled use will vary depending upon originating source.

Recent studies conducted for the Navy by a research and engineering company have concluded that oily waste (consisting of such fuels as JP-5, Navy diesel and distillate, engine lube and hydraulic oils) may safely be blended in small percentage volumes with Nos. 4, 5 or 6 fuel oils and burned in power plant boilers for the production of heat and electricity. The heat value of a gallon of reclaimed waste oil is essentially the same as that of fresh oil, therefore, a gallon of waste oil reclaimed is a gallon of fresh oil saved.

Ship generated oily wastes are, of course, the larger of the two waste oil sources. However, the process of collecting, segregating, and treating the bilge oils is more complicated than shore generated oily waste reclamation. First, most bilge wastes only contain .1% oils. Also, these oily wastes may contain a conglomeration of diesel wastes fuel, turbine lubricants, hydraulic oils, engine oils, cutting oils, and tank cleaners. The mixing of these various fuels, lubricants, and cleaners has an emulsifying effect which retards the natural tendency of the oils to readily separate from water.

To overcome this, a comprehensive shipboard oily waste reduction and treatment program is underway. Oil-water separators will be installed on all ships to treat bilge water. The separated oil will be held in the ships oily waste holding tank. Another tank will be installed for "off-spec" fuel.

Since these shipboard generated wastes will eventually be pumped ashore, there is an effort underway to provide new or improve existing oily waste treatment facilities at ship berthing stations. Three projects are programmed for construction during the Fiscal Years of 75 and 77 and by 1980 the Navy will hope to have environmentally acceptable facilities worldwide.

The reclaimed fuel oil, extracted from ships bilge, ballast, industrial operations, off-spec fuel, will be available for either recycling into the Navy's fuel supply system for use in its ships and power plants or for sale to interested commercial users.

The potential savings from this bilge waste in terms of both energy and fuel dollars is expected to be enormous.

At the Naval Supply Center, Norfolk alone, where limited separation and holding tank facilities are available, 350,000 barrels per year of useable oil are being reclaimed. Similar savings are available at other major Navy complexes.

Survey of Field Energy Conservation

Energy conservation surveys are presently being conducted at naval shore activities by special teams of utility engineers from the engineering field divisions (EFDs) of the Naval Facilities Engineering Command.

The program was established this spring in response to specific Department of Defense direction. The objective will provide all activities with the technical expertise needed to meet the immediate energy consumption reduction goals. More important it is designed to limit adverse effects on fleet support.

Each survey will be tailored to the individual activity but the engineers are directing their efforts toward the following general areas: providing the activity with managerial and technical operation and maintenance guidance to reduce energy consumption; assisting the activity in developing a contingency plan for shortages of specific energy sources; and identifying, evaluating and developing high payoff capital investment projects that will result in energy conservation.

Details on the survey program execution and responsibilities are contained in NAVFAC instruction (4100.6). The guidelines are deliberately general to allow the individual EFD to use professional judgment in applying the depth of technical analysis needed by each activity.

Included in the instruction is a simplified economic analysis. This method enables the survey engineer to get a quick estimate of the potential payback of each project. It also will permit the ranking of projects according to relative payback so that survey engineers can apply their limited time to the most cost effective and immediate essential projects.

In addition to the in-house effort, which will involve approximately 70 EFD engineers and technicians, contracts have been awarded to two A&E firms for in-depth surveys of the Naval Shipyard Philadelphia, Pa. and the Naval Air Station, Oceana, Va. The contractors will develop specific techniques and analysis procedures for use by EFD engineers in conducting future surveys of similar activities.

The program's initial phase began in early 1974. With regard to facilities projects, there will be two distinct efforts. The first involves the development of quick-fix projects which will provide an immediate, high payback in energy use reductions. Along with this, mid and long range conservation opportunities will be identified. These potential projects will require in-depth engineering efforts to apply the technical innovations and system integration essential for maximum conservation.

This initial survey effort is the first step in a total energy conservation program. The projected energy scarcities, cost escalations and tightening budget picture make it imperative that this program continue to integrate all physical and fiscal resources to insure the highest payback for the Navy's investment.

The Navy's mission capability relies on responsive facilities support, and energy conservation must be given the highest priority if we are to guarantee that support. The conservation surveys will add direction to that priority effort.

ENERGY COSTS . . .

SHORE ENERGY COSTS

	JUL 73	SEP 74	INCREASE
NAVY DISTILLATE (Bbl)	$5.54	$15.50	280%
HEATING OIL (Bbl)	$4.63	$16.14	349%
GASOLINE (GAL)	36¢	56¢	155%
COAL (TON)	21.00/TON	47.00/TON	224%
ELECTRICITY (MWH)	12.25/MWH	24.00/MWH	192%
NATURAL GAS (MBTU)	58.1¢/MBTU	101.5¢/MBTU	175%

In the recent past little budget attention has been given to power utilities costs. Costs increased at a more or less reasonable rate. Energy costs were a minor portion of the total package and buried in so many negligible pieces that they generated little concerned attention. In any event the bills had to be paid and the line manager could and did absorb any minor increases within his budget.

But during FY74 energy costs came to the fore. The table gives some idea of the reason for the increased emphasis on more detailed energy budget preparation and management. Some energy prices literally more than tripled during the year.

Energy prices shown in the table represent Navy-wide averages as of September 1974. The cost of purchased electricity and natural gas lagged behind fuel oil costs during FY74 but are now still increasing as the fuel costs pass-through is representing a larger and larger part of commercial utilities. Natural gas prices are expected to rise sharply and eventually approach the levels of oil and coal on an energy basis. Interrupted customers may expect drastic budget impact in FY75 due to the large differential still existing between low cost natural gas and the new market levels of oil.

Until the energy shortage and subsequent leap in prices there was no existing detailed system to monitor actual energy costs vs budgeted cost on anything approaching a real time basis. In order to provide operation cost relief, budgeteers, at all levels of DOD, burned barrels of midnight oil gathering what data they could to support requests to Congress for funds to pay the expected increased bills.

Figure I illustrates this inflationary impact in the context of the Navy's utility bills. This figure conveys graphically the pressure of rising energy costs on Navy utility operating costs. It shows that, even with the achievement of a 15% energy conservation goal, energy costs will accelerate FY75 operating costs by more than 50% and FY76 operating costs by more than 60% compared with historically expected cost increases. These price increase estimates are based on current, probably conservative, assessments of the energy market place.

The prices of utility energy sources are as volatile as the fuels themselves. DOD energy forecasters envision a tripling of natural gas rates in the near future, if it's available. Purchased electrical service rate increases of 30% and over are becoming more and more frequent. No one even blinks at $50 a ton for coal.

This grim picture is compounded by the lag of contract price increases and demands that more detailed attention be given to budget preparation and monitoring of actual costs. All the little pieces of energy costs that have traditionally been buried in facilities operating budgets will have to be dug up and put together. Hopefully, the identification of energy costs on the Defense Energy Information System Report (DEIS-II) will provide the basic information necessary to plead the budget case to Congress. The fact is that the cost aspects of the "energy crisis" may well be every bit as restricting as the decreased availability of fuel. More detailed quantity and cost reporting systems will have to be adopted and used if we are to make the most intelligent use of the energy resources, both BTUs and dollars, available to us.

FUEL PRICE PRESSURE UPON NAVY UTILITY OPERATING COSTS

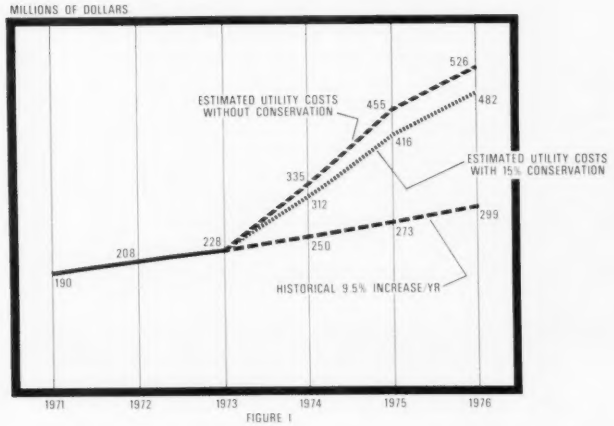


FIGURE I

. . . a budget nightmare!

the success of most programs depends upon

Information and Education

The magnitude of the problems associated with energy costs and possible shortages and their long range nature requires that energy resources management personnel be thoroughly familiar with the Navy's energy programs and actions which should result in optimum energy conservation.

To accomplish this, several education and training programs for managers, engineers, and plant personnel are in development or underway.

The Naval School, Civil Engineer Corps Officers (CECOS) in cooperation with the Naval Facilities Engineering Command prepared and conducted the first Energy Management at Shore Activities course in June. This course was presented at Port Hueneme, Calif., with future offerings scheduled at other locations throughout the United States for regional convenience. The course is specifically addressed to commanding officers, public works officers and civilian engineers of Naval activities supplying or using large quantities of energy.

The instruction is three days in length with the first day for commanders' orientation needed for leadership in energy conservation programs at their activity. Specific topics include: energy sources, uses, and development; federal and navy conservation policies; management actions which can and should be taken at the activity level; application of energy techniques to electrical and mechanical systems, building rehabilitation, and utilities systems controls.

Training courses of building techniques designed for energy conservation criteria are being developed for NAVFAC design engineers. To provide engineers with an immediate tool for in-house design work and a means of checking contractor work, NAVFAC has obtained a computer program known as AXCESS from the Electric Energy Association. This program minimizes building heating and cooling loads by optimizing design variables such as building orientation, architectural and construction features and alternative HVAC systems.

For the long range, a training course is being planned on the application of criteria which will be published in two new energy conservation design criteria manuals. One manual will cover new buildings; the other existing buildings. The manuals which are being developed are scheduled for publication in 1975. They will contain descriptions and comparisons of all major types of heating, ventilating and air conditioning systems and architectural and construction options. Also included will be detailed information on the use of computers for comparing alternative solutions and selecting the most cost effective systems. The training course will last approximately three days and will be tailored for architect/engineer designers.

The NAVFAC Technical Training Center at Norfolk, Va. is presently revising plant supervisor, mechanic, and operator training programs to emphasize energy efficiency at the plant level. A correspondence course dealing exclusively with energy conservation for operators and maintenance personnel is under development and will be available within the next six months. Also, schools and courses on the operation and maintenance of utility systems and facilities are being revised to stress conservation actions. It is estimated that this training of public works personnel can by itself achieve a ten percent reduction in energy use.

The common objectives of these programs is to provide Navy personnel with the perspective and tools so that each can contribute the maximum to broad scale programs to conserve energy.

CECOS Energy Management at Shore Activities Course

Topics

Federal Energy Administration & Department of Defense Energy Programs
Navy Energy Programs
Facilities Research & Development
Activity Energy Conservation Program
Electrical Energy Conservation
Mechanical Energy Conservation
Economic Analysis and Project Preparation
Energy Conservation Design Criteria
Building Rehabilitation and Operation to Conserve Energy

Instructional Methods Include: group discussions, case studies, student presentations, lectures and workshops.

Less Energy Use With

Boiler Improvements

Throughout The Navy

Air pollution, accelerating fuel costs and the generally deteriorated state of most boiler control systems at Navy activities emphasize a rather basic concept: *reduce pollution by reducing fuel consumption.* Two programs have now been initiated to improve the operation of the Navy's boiler plants. The BTU (boiler tune-up) program includes all boilers over 5 million BTUH output capacity. The Boiler Efficiency Improvement Program is tailored to the usually unattended, smaller units with less sophisticated control systems.

The "tune up" program has two distinct stages for correcting plant deficiencies. The first step is to establish and attain a level of boiler performance that is consistent with clean, efficient operations. To establish this "baseline" NAVFAC engineering field divisions (EFDs) will conduct a series of inspections and tests on each unit. This work culminates in the calibration of automatic combustion controls to maintain combustion at the most efficient air-to-fuel ratios over the entire load range. The EFD has the additional responsibility of summarizing for the activity the necessary maintenance deficiencies and resources requirements so that funds can be made available for repair/improvement projects resulting from the inspections..

The second phase of the work involves source emissions testing (stack gas analysis) the results of which will be utilized in determining requirements for pollution abatement equipment.

At this point, most of the 450 plants in the "tune up" program are either undergoing maintenance work to ready them for the second phase or are in various stages of testing and adjustment. Tune-up work on 53 boilers shows that $1,500,000 savings can be achieved annually.

The present goal is to complete both the optimum performance test and source emission test on all boilers by the close of FY77. Pollution problems for the majority of the boilers should also be identified and corrected by that time.

The number of boilers in the BEIP program is more than 10 times that of the "tune-up" program — 4,800 units versus 450 units. However, the work is generally limited to burner calibration and adjustment; and with the simple controls systems involved, the operation is not any more complicated than adjusting an automobile carburetor. Since premium fuels, such as gas and low sulfur oil, are predominantly used in the smaller units, pollution is not considered a major problem.

The BEIP program is to be accomplished by EFD technicians. Technician training is in progress and field work in some areas are to begin this fall. Savings resulting from the increased efficiency of these smaller boilers will at least equal that of the larger units being upgraded in the "tune up" program.

An additional benefit of these boiler improvements is the on-the-job training and experience that the activity plant personnel will receive as they work on a day-to-day basis with manufacturers representatives, A&E contractors, EFD engineers and technicians. This will contribute substantially to a higher level of utility system reliability and should insure that the conservation benefits obtained at the time of equipment adjustment are maintained.

. . . and combustion devices too

Over the years a great deal of thought has been given to improving fuel burning devices. The Naval Shore Establishment has been exposed to a good deal of this thinking in the form of different types of oil burners developed to exploit the operational problems incident to the combustion of residual fuel oils.

Devices utilizing compressed air introduced to create turbulance in the combustion zone, systems using water mixed with the fuel, and many other ideas have been promoted. Many questions remain concerning the economics and performance of these and other innovations. NAVFAC, consequently, is sponsoring a study directed at answering some of these questions. The Civil Engineering Laboratory, Port Hueneme, will lead the study and the Naval Ships Engineering Center, Philadelphia Division, will provide assistance. The effort will involve a literature search directed at determining the state of the art and identifying equipment that warrants testing. The final phase will be actual thermal performance testing and source emissions testing of equipment set up in an actual boiler at the Philadelphia Boiler and Turbine Laboratory.

Analyzing Existing Structures For Energy Requirements

The study described in this article and undertaken by NAVFAC's systems analysis division in conjunction with NAVFAC's mechanical engineering branch supports the request of the Chief of Naval Material for a statistically oriented analysis of the naval shore establishment to: provide early identification of the scope of energy savings vs. investment costs for program funding formulation, and provide information concerning relative payoffs in energy conservation, by building use and location and by type of fix, for use in program management.

The study was initiated with an analysis of the existing Navy Shore Establishment, so that building design parameters affecting energy consumption could be identified, and statistically "representative" buildings could be selected.

Accordingly, a mathematical sample was devised against the approximately 30,000 buildings located in the continental portion of the Navy real property inventory. (The population of the sample included Alaska and Hawaii). The sample was structured so that climate zones, category codes and types of construction could be identified. A sample of 2,500 buildings was deemed necessary to return a confidence of 95% that "representative" buildings would, indeed, be defined.

A design analysis worksheet was then sent to approximately 300 activities owning the 2,500 buildings selected in the sample. These activities were requested, via the worksheet, to provide building information such as: building exterior wall construction including orientation; percent of glass, color and orientation; roof construction; area; color and interior subceiling; windows, including type, dimension; design ventilation; lighting levels and equipment load; heating/air conditioning system including type of fuel and type of system; and building-hours of operation.

Worksheets were received from approximately 290 activities which accounted for approximately 2,400 buildings. Feasible energy savings "fixes" (output in BTU savings) and costs ($/SF) for each "fix" were then determined by in-depth design analysis. This analysis included consideration of such energy reduction fixes as: increasing wall and roof insulation, installing storm windows and/or sun screens, decreasing design lighting levels, changing the color of exterior walls and roof, and decreasing the design ventilation rates.

As a result of this analysis, three "fixes" — increasing wall insulation, increasing roof insulation and installing storm windows were determined to be highly beneficial and necessary for conservation of energy. The remaining fixes were, in most instances, already included or considered in the original design and use of "representative" buildings or, as in the case of sunscreens, were economically unjustified. Using this "fix" data, total Navy energy savings and investment data were then extrapolated.

Since fiscal constraints could preclude the implementation of all economically justified fixes to all buildings, however, an objective alternative-ranking mechanism is required to facilitate identification of the most desirable energy conservation strategy.

The mechanism appropriate to this task and this study is discounted life-cycle benefit /cost analysis which utilizes all the previously outlined analytical data as inputs and yields a preference ranking of all possible energy conservation measures identified in this study.

The information extracted from the study data and graphs yielded the following finds and recommendations:

- The magnitude of energy savings and magnitude of economic payoff are not directly correlated (e.g., the achievement of one does not guarantee the achievement of the other). The most efficient allocation of dollars, therefore, considers both the energy objectives and the payback economics.
- If there were no fiscal constraints and *all* economically justified fixes to all buildings in the Navy (50 states) were implemented, the total navy energy conservation capital investment program budget would require *$576 million* (See Figure I, Curve I_c which, in turn, would save *19 trillion life-cycle BTUs* in raw energy. The dollar value of life-cycle savings for the above total investment would $1½ billion (See Figure I, Curve E_c).
- Correcting *68%* of the projected fixes will save *86%* of the total energy with *48%* of the total investment (See Figure I, Curves E_c and I_c). Correcting 68% of the project fixes will also yield a savings of 575,000 BTUs per $10 (See Figure I, Curve A), and a project payback period of approximately 5.7 years or less (See Figure I, Curve B).
- The 5-year program target funding level in today's dollars should be *$275 million* — to achieve 68% of the fixes.

The statistical model subsequently became a major factor in estimating funding levels for the Energy Conservation Investment Program.

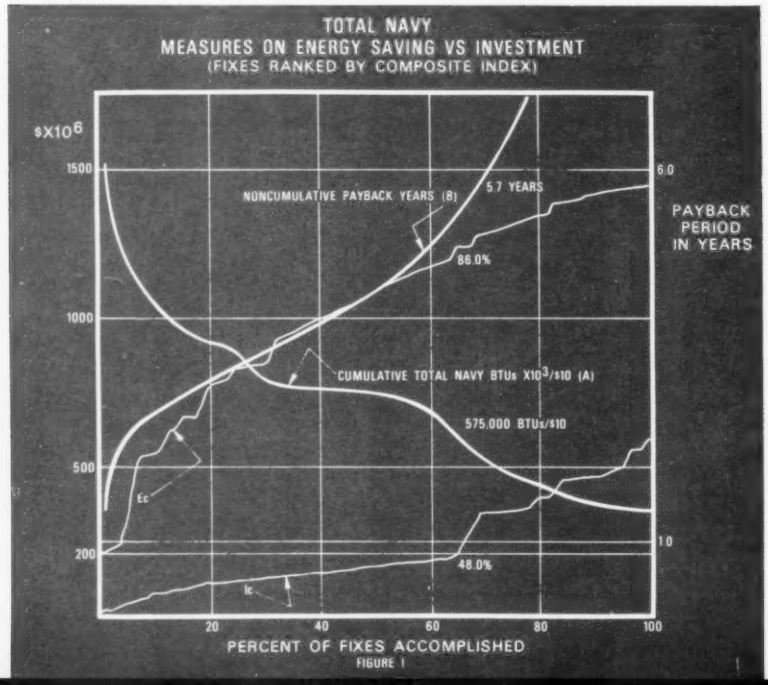
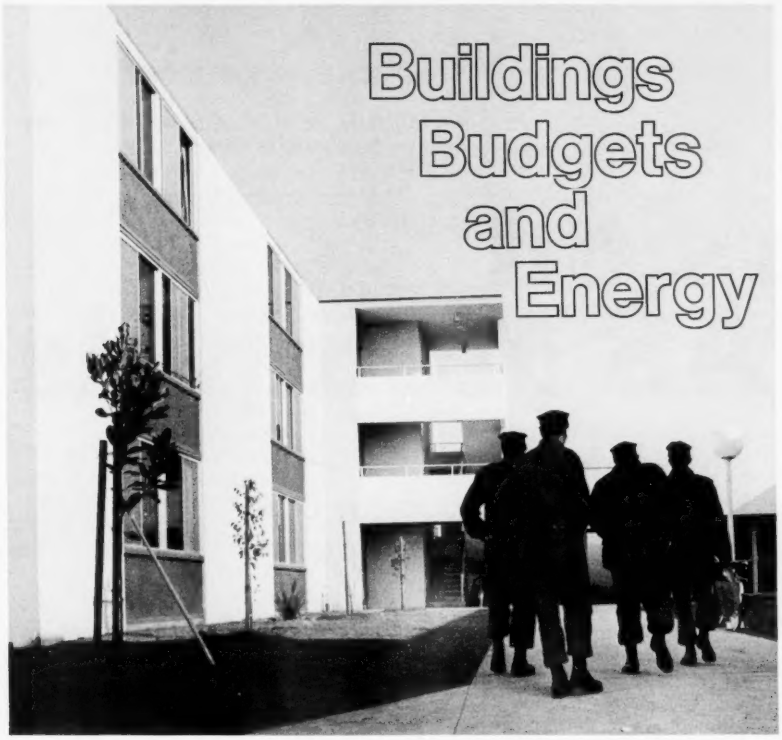


FIGURE I



Buildings Budgets and Energy

With the dramatic serious oil and gasoline shortages last winter, it suddenly became imperative to conserve energy. Yet perhaps the idea should not have seemed so novel, nor the reality so stark. Making judicious use of energy is a lot like making judicious use of money, and the latter problem has long been familiar to budgeteers.

The result of the critical energy situation, was that questions of money and energy are beginning to come together in the administration of the Naval Shore Establishment. Energy-related objectives fall into two general categories: maximum possible reduction of energy consumption by existing naval shore facilities and most efficient use of energy in shore facilities yet to be acquired.

The main fiscal objective, of course, is to minimize the Naval Shore Establishment's annual energy bills. In general, these energy and fiscal objectives are rather well correlated. Economic analysis, applied on a case-by-case basis, can be an effective tool for investigating funding implications in either of the energy-objective areas cited above.

Suppose, for example, it is proposed to reduce the energy consumption in an existing building by improving wall and roof insulation. From an economic standpoint, what is involved is a trade-off between the dollar amount of future energy savings and the original investment necessary to achieve those savings. An economic analysis of such a project would include the following general steps:

1. Estimation of the remaining useful economic life of the building (in years).

2. A detailed cost estimate of upgrading wall and roof insulation.

3. Projection of the building's current heating/cooling bills over the remaining economic life (assuming no insulation improvements).

4. By a comparison of seasonal design temperatures and an analysis of insulation composition, thickness, and thermal conductivity, projection of energy consumption over the remaining economic life if insulation is upgraded. Translation of energy projection into dollar projection by the application of unit energy costs.

5. Projection of life-cycle dollar savings attributable to the insulation project (the difference between the projections of items 3 and 4 above).

6. Calculation of *present-value* life-cycle dollar savings in accordance with existing Department of Defense economic analysis guidance.

7. Comparison of present-value savings against the investment cost, to see if the insulation project is economically justifiable.

A study completed at NAVFAC Headquarters in April, 1974, has indicated that many potential energy-saving projects *are* economically feasible, *particularly* those involving wall and roof insulation and the installation of storm windows. A statistical sample of buildings selected from the Naval Shore Establishment inventory indicated that the economically most attractive projects can achieve payback (amortization of investment costs by present-value dollar energy savings) within 2-5 years.

Experience in improving energy efficiency of existing shore facilities is the key to more far-sighted planning of new facilities. Questions which would have seemed innocuous only a few years ago are now being asked with increasing frequency at the facilities design stage. What are the present and projected price trends for the various fuels? Should oil-fired boilers have a coal conversion capability? To achieve maximum economy in shore-facility energy consumption, how should buildings be configured? How should they be oriented? How much insulation should they have? What type of heating/cooling systems? What are the best wall and roof colors? Is it possible to reduce design lighting criteria?

Current guidance for the preparation of program cost estimates in support of military construction projects specifically requires the performance of design-type economic analyses to determine the feasibility of incorporating energy-conserving features.

The procedures in such analyses are much the same as those outlined above. Frequently, there is a tradeoff between a higher initial investment cost and lower annual recurring expenditures during a facility's life cycle. The economically preferable alternative is the one having the least *total* present-value life-cycle cost.

A crucial element in any economic analysis of energy consumption is the potential impact of inflation. Within the past 12-18 months the prices of the most important fuel have risen at an unprecedented rate. It is likely that fuel costs will continue to escalate more rapidly than the general price level in the foreseeable future.

Failure to reckon with this possibility could result in a gross understatement of life-cycle savings in energy-reduction proposals, and perhaps lead to a poor economic choice in an energy design analysis of a new facility.

An old tool — economic analysis — is gaining prominence in a relatively new domain of interest — energy. This is a healthy trend; in fact, it is essential if decision-making in this highly visible area is to evolve into an objective rather than an intuitive or "guesstimative" process.

Steam Conversion at NAS Memphis

By LCDR D. W. KONOLD, Jr., CEC, USN
Assistant Public Works Officer
NAS Memphis

- no big deal;
- just practical applications
- with substantial results

The deep thinker may reason that the unattended desert flower produces no fragrance or that a tree falling in the forest alone makes no sound, but it doesn't take a philosopher to discover that energy expended without benefit to people is not consumption but waste.

Wasted energy works a travesty against the abundance given to the American people and could eventually put a strangle hold on the nation itself if swift and effective measures are not launched to level this proverbial molehill which has now been recognized as a mountain.

Even though a popular comment questions the actual existence of an energy "crisis," it still remains true that our present energy resources are increasingly being depleted. While scientists are investigating new sources of energy, conservation is the only effective tool available each citizen for aid in moving the energy shortage mountain. General opinion has labeled energy conservation as basically ineffective. Rated as a pick-and-shovel operation that can't begin to move a mountain, energy conservation programs have been mentally moved to the scrap pile by some hoping that the energy problem mountain will erode away, or that some mountain moving equipment will suddenly come upon the market.

Manual (working party) labor is a Navy time-tested method of getting a job done and by the same token, a well coordinated, command controlled, conservation program does produce savings.

Conservation of utilities has always been considered an important aspect of Navy life. NAS Memphis has not excepted itself from this policy. To the contrary, a strong utilities money saving program has always been in progress. However, when the Chief of Naval Operations directed additional Navy emphasis in the fall of 1973, it was obvious that the previous NAS Memphis conservation program needed revision. Like many other Naval installations, NAS Memphis is composed of a variety of building types; 350 major buildings in all, not including family housing. About 50% of the structures are wood-frame WW II vintage; the remainder are newer and more efficient, but all differ in design and composition. It was believed that a new base-wide program would reap large benefits (over and above the specific measures directed by higher authority) and would be necessary to reach established goals. It was estimated that the maximum savings that could be expected from a new and heavily advertised voluntary conservation program (when conservation had already been strongly emphasized) would be in the vicinity of 5%. The Navywide goal had been established at 15% reduction from the FY73 power consumption and therefore strict dependence upon voluntary action was considered insufficient.

A plan that would reach down to working levels with detailed direction was desired, but to attempt to analyze each building and establish an individual building conservation program fitted to the building type, its function and working hours, was not practical and would result in a long process that would be too complex and expensive to implement, monitor and enforce.

To successfully implement a base-wide non-voluntary conservation plan, various important aspects were considered desirable. The program should be streamlined, uncomplicated and consistent in its application. Further, success should not rely upon the memory of a multitude of people but have one central coordination point equipped with sufficient authority and means for rapid communications with all participants.

Because the winter heating season was approaching, attention was concentrated in this area. The majority of heating at NAS Memphis is by steam and 95% of the steam is generated by four major steam plants burning natural gas and number 2 or 6 fuel oil (when the natural gas is interrupted). A number of buildings (including family housing) is heated by direct fired gas furnaces and only eleven buildings are heated electrically.

The plan that was finally adopted had its start at an energy conservation brainstorming session and involves the systematic and simultaneous reduction or elimination of heat to all buildings (excluding living quarters) when the temperature permits.

If the outside temperature during working hours rises above 60° F, the steam to all buildings is shut off and, if the temperature prediction overnight or over weekend is 25° F or higher, the heat is shut down at the close of the workday and remains off until the next workday. Although this plan appears to be non-spectacular, it had evidently been overlooked in previous years or had been presumed as standard procedure without special emphasis or central coordination and, of course, without any measurable results. The basic concept is simple, and simplicity was stressed in every phase of the conservation plan.

Results of the Plan

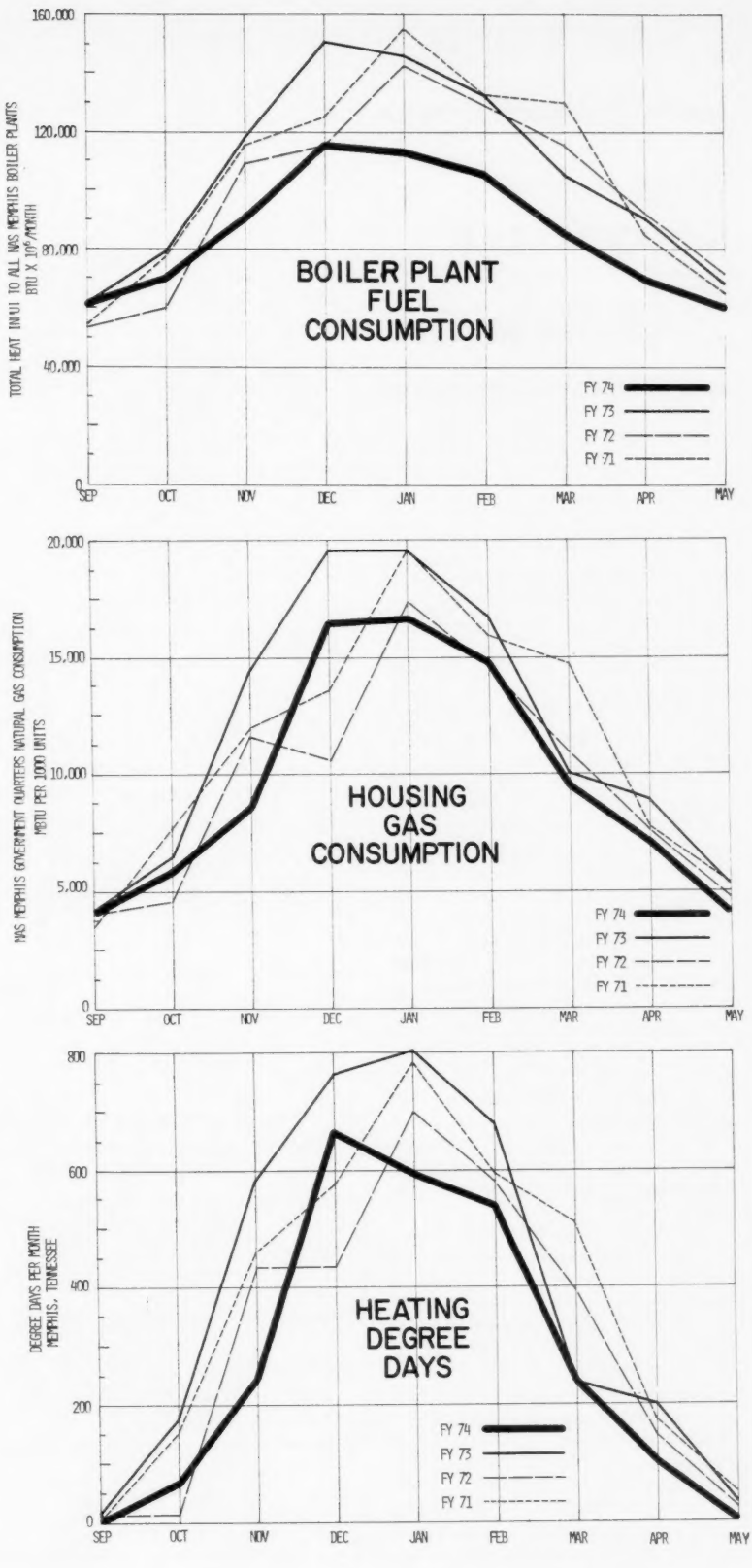
Examining the results requires more study than may be expected because the measure of energy consumption is effected by more than just conservation practices. Figures 1 and 2 compare month by month energy consumption for FY71 through FY74. A cursory examination of these graphs reveals that an accumulation of energy savings has occurred; however, a question is posed: how much savings can be attributed directly to conservation effort?

The two major factors that could have affected heating energy consumption at NAS Memphis between FY73 and FY74 (other than conservation) were weather severity and changes in the heating requirement. The overall station heating requirement was closely balanced between FY73 and FY74 and therefore this is not considered as a significant factor. Conversely, the effect of weather is shown to be considerable. Figure 3 (which is a plot of degree days recorded for Memphis, Tenn., base 65° F, for FY71-74 shows graphically how mild the FY74 winter was compared with FY73. This could account for some or all of the savings, but exactly how much? The answer to this question is surprisingly simple.

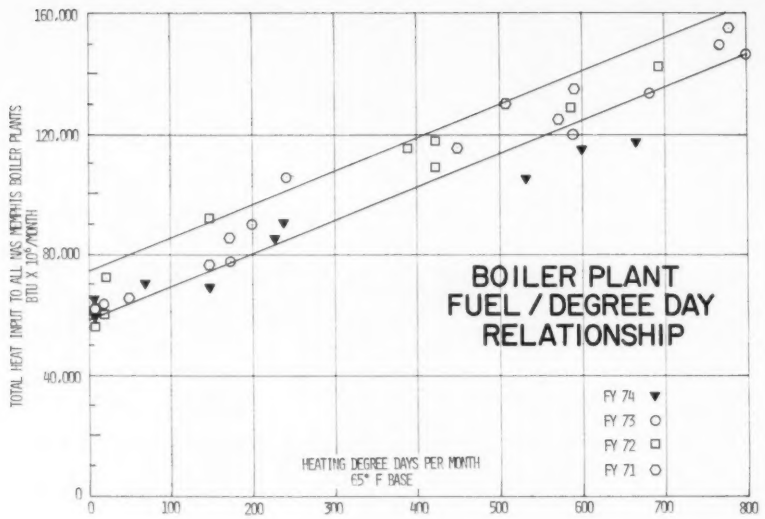
The method used to correlate weather to heating requirement is the degree-day (DD) index. Figures 4 and 5 correlate energy consumption and weather and were developed by Carl Schwerin, head of the public works mechanical engineer branch. This correlation resulted in an envelope of points representing a range of consumption expected for any given monthly weather severity measured in degree-days. Each monthly heating energy consumption value for FY74 is plotted on this chart and if the plot is in the lower portion of the envelope, it is logical to conclude that conservation of energy may have occurred independent of weather conditions.

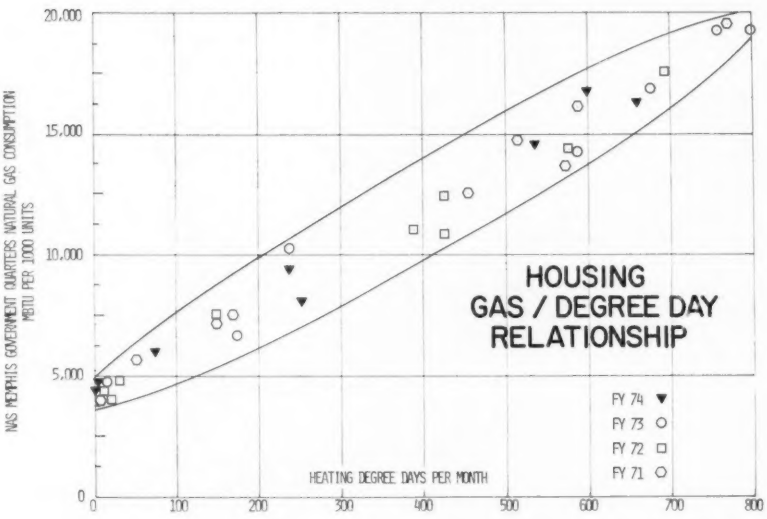
If the plot falls below the envelope, then conservation of heating energy is certain. The saving is assumed to be directly proportional to the difference between the plotted consumption value and the consumption value of the median of the envelope at the appropriate degree-day reading.

Because the new conservation heating plan did not apply to government housing, the comparison between savings in housing versus the central steam plants gives an indication of the impact of a strictly voluntary effort compared to a conservation plan that is directed from the command level



Steam Conversion at NAS Memphis





(Continued from preceding page)

and implemented through the chain of command. It is apparent from figures 2 and 5 that very little of the conservation recorded for family housing can be accounted for independent of weather conditions, whereas, significant savings have accumulated independent of weather elsewhere throughout the station.

Therefore, there exists significant merit (close to ten percent saving for the year) for instituting a centrally coordinated and command directed conservation plan in addition to efforts to encourage strictly voluntary conservation participation.

How the Plan Works

The NAS officer of the day is the key coordinator of the plan and, as such, he monitors the temperature and sets heating conditions as appropriate.

When the officer of the day sets a heating condition he passes the word to all tenant commands and to each NAS department.

It is then the responsibility of each command or department to relay the information to the building representatives.

The backbone of the plan is the assignment of a conservation representative for each building. This duty is usually given to an individual at the working level whose normal duty assignments are associated with upkeep of the building or grounds; often the individual assigned has simultaneous assignments as the fire warden or building maintenance representative. It is the conservation representative's basic responsibility to turn the heat off or on to the building when heating conditions are set. There is no formal training for the building representatives; however, Public Works personnel are sent out as necessary (on an on-call basis) to familiarize building representatives with the location and operation of steam valves, the operation of tamper-proof thermostats or other familiarization training.

The following briefly explains the criterion for setting each condition:

CODE WORD	Heating Condition Criteria
CUT OFF:	Daily heat shutdown when outside temperature rises above 60° F.
COLD IRON:	No heat overnight or weekend.
STEAM:	Provide minimum heat (35° to 40° F.) after hours when extreme cold weather is predicted (below 25° F).
REHEAT:	Emergency turn-on of heat by command and public works duty section/recall if weather unexpectedly turns excessively severe.
SHUT DOWN:	Emergency shutdown of base functions (excepting BEQ, BOQ, dining hall, and other as specified) when fuel supply becomes critically low.

The plan was implemented by all eighteen separate tenant commands at NAS Memphis and was coordinated through the Navy-Memphis Energy Conservation Panel composed of executive officers from each major command.

It is apparent that significant amounts of energy can be saved through a coordinated and systematic application of the adage — if you don't need it, turn it off. The results of this conservation program are certainly not earth shattering, but it does add to energy conservation mountain moving.

Naval Facilities Engineering Command
SITUATION REPORT

ECONOMIC ANALYSIS HANDBOOK -- The Economic Analysis Handbook (NAVFAC-P-442) has tentatively been revised to provide updated guidance on how to handle inflation and other cost escalations in economic analysis. This revised edition also places increased emphasis on the use of sensitivity analysis to insure that analytical findings are well founded. Draft copies of the updated manual are currently being used by CECOS in presenting the one week economic analysis course. Finalization and distribution are expected to occur early in Calendar 1975.

16 U.S.C. 670a-f AMENDED -- The original bill known as "Sikes Act" was passed in 1960 to promote effective planning, development, maintenance and coordination of wildlife, fish and game conservation and rehabilitation on military lands. The Act has been amended to provide that activity cooperative management plans include (1) fish and wildlife habitat improvement, (2) range rehabilitation, and (3) control of off-road vehicles. The amendment also authorizes annual appropriations not to exceed 1.5 million for the Department of Defense and 2.0 million for the Department of Interior to carry out the Fish and Wildlife Program beginning in FY76. The Navy portion is estimated to be $300,000.

SEISMIC EVALUATION OF SUPPORTS FOR EXISTING ELECTRICAL-MECHANICAL EQUIPMENT AND UTILITIES -- A NAVFAC sponsored field survey and investigation of seismic effects on supports for existing electrical and mechanical equipment and utilities has been completed and a report prepared. This report provides a summary of typical representative equipment support and restraint systems, and utility systems, required modifications to these systems, cost estimates for the modifications described, and cost and connection (i.e., required number and size of anchor bolts) estimates for a range of equipment weights . Also included are approximate equipment weights related to equipment parameters (CFM, KVA) to be used only for rough cost estimating, "plates" showing details of acceptable restraint connections, and calculations of investigated elements. The report should be used as a guide for improving the seismic resistance of existing mechanical and electrical equipment and utilities.

Naval Facilities Engineering Command
SITUATION REPORT

OPERATION STREAMLINE -- NAVFAC, in conjunction with Northern Division, NAVFAC, and the Public Works Department, Philadelphia Naval Shipyard, is developing and testing a new Production Management System for Public Works Departments Maintenance operations. More efficient public works maintenance operations are being achieved by streamlining the maintenance management system, keeping principles of good management incorporated, and relying to a great extent on the abilities of individuals performing day-to-day operations; by reducing overhead expense (people and paperwork); and by using available computer technology to minimize costs and maximize performance.

UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES - - Approval of the University space program has been received from the President, USUHS and the Board of Regents. Final design of the USUHS Interim Facility of the Armed Forces Institute of Pathology is on schedule with construction to be completed in time to accommodate a first class of 36 medical students in September 1975. Completion of the final design of the first phase of the USUHS (FY75 MCON) is scheduled for February 1975 with anticipated construction contract award in early May.

FACILITIES/CONSTRUCTION CONTINGENCY STUDIES; A NEW APPROACH -- Since 1950, NAVFAC Headquarters has been preparing and publishing studies on the capabilities of ports and airfields and the availability of construction resources in countries and regions throughout the free world. Some 75 countries have been covered. The studies are provided to OPNAV and the Fleet Commanders-in-Chief for their use in planning for contingencies. Many of these studies are now out of date. In order to maintain the viability of this function under conditions of constrained resources, future studies will be prepared and published in automated format. NAVFAC Headquarters and FACSO staff are now in the process of developing the necessary files and programs to support this new approach. The first study in automated format will cover the southern portion of the CINCLANTFLT area of responsibility and is scheduled for completion in April 1975.

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) -- Prospects for additional Military Construction and Family Housing funds for FY76 now appear good for modification of existing facilities for energy conservation. This is a new program which will help activities fix up those buildings and utilities systems where a high energy savings can be demonstrated. Design is now being authorized for FY76 projects and authorization for FY77 has been requested. With continuing emphasis on energy conservation, the ECIP will continue through FY81. Candidate projects should be nominated via EFDs and Major Claimants to NAVFAC (Code 102).

RECALLS -- The Civil Engineer Corps has openings for officers to be recalled to active duty. The criteria for recall are based on relative age, professional qualifications, and service needs. Currently the Corps is seeking officers in the ranks of Lieutenant and Lieutenant (junior grade) for recall. Reserve officers on active duty who desire voluntary extended active duty should submit an application for recall to Extended Active Duty, NavPers 1331/5, directly to the Chief of Naval Personnel, or contact the Civil Engineer Corps Detail Office at 202-694-2296.

CAPTAIN SELECTEES - The following commanders have been selected for promotion to the rank of captain: Charles P. Andersen, XO, SouthDiv, Charleston, S.C.; William F. Daniel, Jr., PWO, NavWpnCen, China Lake, Calif.; Theodore M. Edson, OASD (Systems Analysis), Wash., D.C.; Roy D. Gaulden, Jr., PWO, NavSta, Rota, Spain; R. Dillard George, Jr., Asst Commander for Facilities Planning, NAVFAC, Alexandria, Va.; Jack B. Moger, NAVFAC, Alexandria, Va.; Donald A. Morton, NavCompt, Wash., D.C.; Russell P. Nystedt, PWO, NavSta, Guantanamo Bay, Cuba; Edward R. Oscarson, LantDiv, Norfolk, Va.; Albert R. Socha, Jr., OIC, CEL, Port Hueneme, Calif.; John P. Sylva, PWO, FleSuppO, Athens; John W. Tombarge, LantDiv, Norfolk, Va.; Robert J. Westberg, XO, PWC San Francisco Bay, San Francisco, Calif.; Bruce Wile, IndColArmFor, Wash., D.C.; and Jesse R. Williams, WestDiv, San Bruno, Calif.

Naval Facilities Engineering Command
SITUATION REPORT

NATIONAL NAVAL MEDICAL CENTER -- Final design of the NNMC modernization projects (FY75 MCON) is on schedule with anticipated construction contract awards in the spring and summer of FY75. Concept development for the replacement NNMC hospital (FY76 MCON) is on schedule. Block concepts have been reviewed and the design is proceeding toward prefinal concepts.

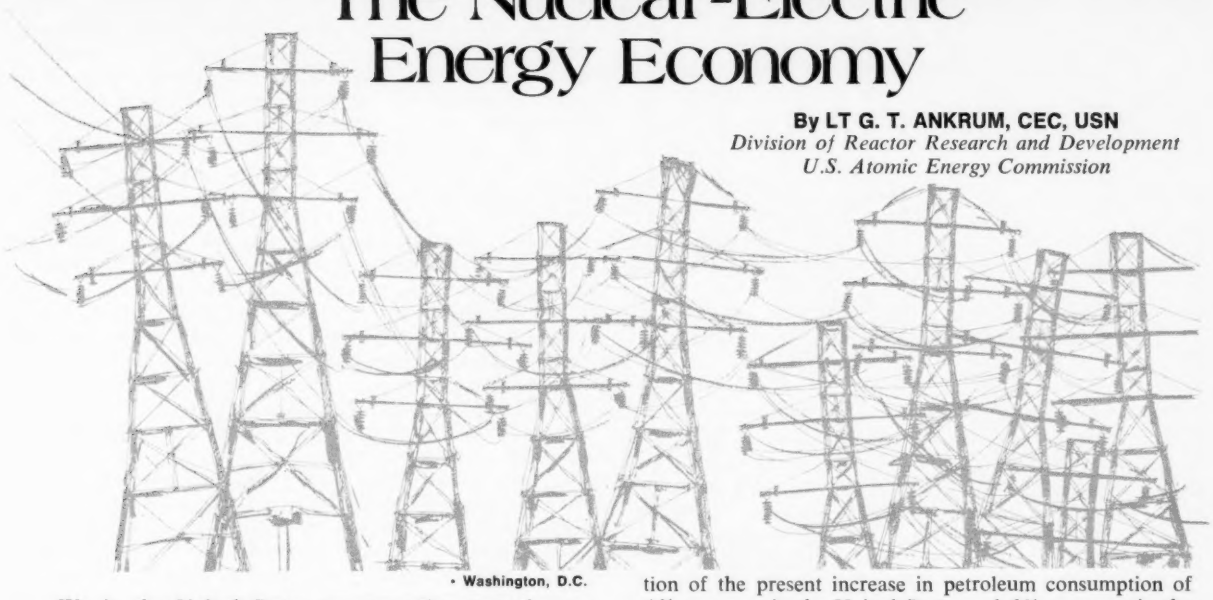
SOLAR HEATING AND COOLING DESIGN CRITERIA -- NAVFAC has tasked the Civil Engineering Laboratory with the development of practical design criteria for solar heating and cooling systems applicable to the type of buildings found on Naval and Marine Corps Facilities. These criteria will be based on cost effectiveness, experience with various designs, availability of hardware, geographical location, etc. They will be published in design manual form and should be available by August 1975.

OIL SPILL BARRIER (BOOM) ARRIVING AT THE SCENE -- NAVFAC accepted the first article of its FY74 procurement of seventy-seven thousand feet of oil spill barrier and associated hardware in Seattle, Washington on 27 September 1974. The procurement supplies Harding Pollution Control boom to many of the more than eighty activities world-wide receiving oil spill cleanup equipment under the Environmental Quality Division's Oil Spill Cleanup program. All boom under the FY74 contract will be delivered by the end of March 1975.

ENVIRONMENTAL CONSIDERATIONS OF NAVY DRYDOCKS -- Based upon EPA requirements for discharge permits, the San Diego Branch of WESTNAVFACENGCOM has been directing investigations into waste characteristics of drydocks at the Long Beach NAVSHIPYD. A meeting held at NAVFACHQ on 13 November 1974 between NAVSEA, NAVFAC, OP-45 and others exchanged information and arrived at a course of action. Floating drydocks, under NAVSEA cognizance, will receive CHT systems and a simple sandblast grit removal system. OP-45 will apply to EPA for a permit to cover all floaters. The graving drydocks at Long Beach will be studied by an A&E to determine the best way to segregate waste streams and treat the wastes. This study should be applicable to other drydocks. Results will be disseminated to all EFDs upon completion.

The Nuclear-Electric Energy Economy

By LT G. T. ANKRUM, CEC, USN
Division of Reactor Research and Development
U.S. Atomic Energy Commission



• Washington, D.C.

We in the United States are presently attempting to recover from a situation in which we were unable to acquire petroleum in the quantities to which we had become accustomed. These shortages caused severe disruptions in life styles, unemployment, construction practices, manufacturing processes and a myriad of changes in other areas. The shortage had been developing over a period of years and was intensified by a large bloc of petroleum exporting countries acting in unity to gain a political objective by reducing crude oil production. Taking advantage of their new found unity, these petroleum exporting countries then acted to significantly raise the price of crude oil.

The recent critical phase of the shortage is now easing through a return to previous production levels by the Arab states, but the high prices remain and an overall petroleum deficit will continue indefinitely.

The average American is confused as to the reasons for our dependence on foreign sources for our oil, the ultimate U.S. and world oil supply and whether or not there is a real shortage of oil in the United States. What does not appear to be in disagreement is the determination of the petroleum exporting countries to charge what their energy source is worth — to charge what they think is the fair market value rather than to base the price of crude oil on its cost of production, as was formerly the case. In terms of their energy content as compared to other sources of energy, petroleum and natural gas have been relatively inexpensive to produce. Competitive pressures have heretofore kept prices commensurate with their production cost and consequently, the United States and the world have come to depend on oil and natural gas for their energy needs. The United States has a fossil fuel energy economy with direct combustion of oil and gas the dominant mode of end use. In 1973, the United States imported 35% of its petroleum needs. Oil and gas furnish nearly 80% of our energy but make up only 3% of our known fossil energy resources. Geologic studies of the earth aimed toward predicting the world's ultimate supply of oil and natural gas have yielded predictions of a supply much larger than just the known oil reserves. If we assume that there will be no effective energy conservation, extrapolation of the present increase in petroleum consumption of 4% per year in the United States and 6% per year in the world and comparison with predicted ultimate U.S. and world supplies indicates that easily recoverable oil is being rapidly depleted and ultimate supplies could be exhausted in the next century. We can sharply reduce our dependence upon oil and gas by shifting to the energy sources that are plentiful — uranium and coal.

For most purposes, these two fuels have to be converted to electricity, for distribution, a requirement that applies to practically every other significant energy source except synthetic fuels. Geothermal steam in California won't heat your house in Minnesota. The wind or tide in Maine won't illuminate a farmhouse on the plains. The sun in Arizona isn't going to run a production line in Gary, Indiana. All the energy sources that might replace oil and gas must first be converted to electricity. The way to solve our energy shortage will be to use more electricity in the years ahead — not less.

Understand that this is not a call for wasting electricity, but a shift to electricity from other energy forms. The President, in his Energy Message to Congress in January 1974, called for alleviating the near-term shortages of energy by increased production of domestic oil and gas, increased production and consumption of coal, accelerated construction of nuclear power plants and increased conservation of energy. For the long term and permanent solutions, however, he considers that advanced nuclear power plants, nuclear fusion and solar power are the only sources of energy capable of meeting America's energy needs. For the years of 2000 and beyond, nuclear-electric energy economy could be established in which nuclear energy will be the major source of energy and electricity its form of use.

What will be needed to make the shift from our present fossil fuel energy economy to a nuclear-electric energy economy? It has already become more economical in some cases to use nuclear power plants to generate electricity in place of fuel oil. An increasing proportion of electric generating power plants now ordered for construction in the United States are nuclear powered. Some countries (France, Spain, Taiwan, Japan, Denmark, Switzerland)

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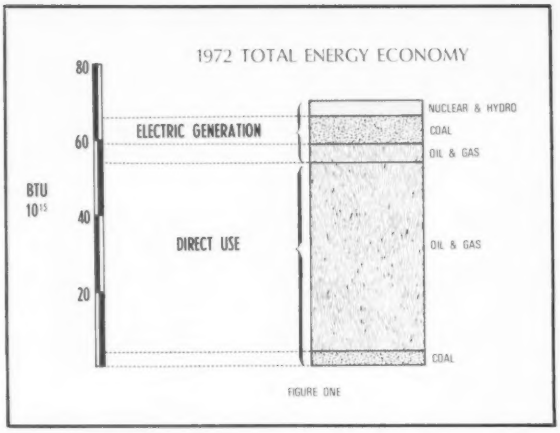


FIGURE ONE

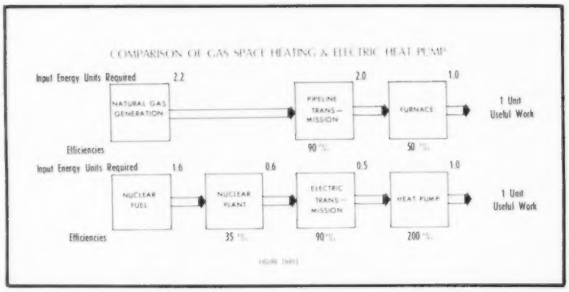
have embarked on a national policy requiring all new electric generating facilities to use nuclear power. Many other countries, including the United States, may soon join them in this action. Additionally, extensive research and development of breeder reactors and nuclear fusion power continues. Except for solar power research, and development of coal gasification and liquefaction, little additional can be done in the area of shifting our primary source of energy away from petroleum and gas. In the area of the use of that energy, however, considerable work must be done. As you examine the different end uses of energy, two things stand out. First, electrical energy is surprisingly insignificant in all but a few of these end uses. Second, except for the transportation sector and the petrochemical feedstock area, the end use of the non-electrical energy sources is heat in one form or another. Many of the significant substitute energy sources initially generate their energy as heat, which then must be converted to electricity at 33% efficiency for distribution to end users. Electricity can then be converted back to heat energy at 95%, or greater, efficiencies. Big industrial users of process steam or direct heat could have their own energy source, be it cial, solar or nuclear and generate their heat energy directly for 100% efficiency. Using electricity to generate heat for the end user will almost always be less efficient than burning pertoleum or natural gas as a direct fuel, because converting heat energy to electricity wastes 67% of the source heat. The point to remember is that non-petroleum heat energy will be available in sufficient quantity to allow a conversion efficiency of only 33%; whereas, there may not be enough petroleum or petroleum substitute fuels available for burning as a direct fuel, even at 100% efficiency. In one case, that of space heating for homes and business, recent improvements in electric heat pumps make them more efficient than natural gas furnaces. The transportation sector is also amenable to a partial conversion of electricity. Electric vehicle technology is making rapid advances and industry sources are now predicting 5 million electric cars in service by 1985. There is no reason why all passenger vehicles operated in urban or suburban environment cannot be electric, and in fact, electric cars are more efficient than the gasoline automobiles they replace. Actual tests in which a conventional post office delivery van and an electric van traveled the same route at the same time yielded an energy cost of six cents per mile for gasoline vs. one cent per mile for the electric van.

Other areas of the transportation sector offer additional opportunities for electric substitution. These include: fifty percent of the trucks — those used for urban delivery; all intracity buses and rapid transit; and all freight and passenger trains. Many people will remember that the Northeastern United States railroads were electrified prior to the general use of diesel locomotives and others will remember that several large cities, including San Francisco, still use overhead trolley wires to power their electric buses. Nuclear propulsion for large ships has already been successfully demonstrated. Remaining users of petroleum in the transportation sector are airplanes, small ships not suited for nuclear propulsion and large interstate trucks. These are uses for which no economically viable substitute for petroleum can now be identified.

The future effects of a shift to the nuclear-electric economy will be manifold. Our petroleum consumption must decrease. Because the energy sources which are capable of replacing petroleum distribute their energy most efficiently as electricity, the proportionate use of electricity must increase. Substantial increases in electricity usage can only be achieved by substitution of electric energy for petroleum uses. The cost of petroleum products must increase to the point that it is more economical to use electric energy which has been generated with coal or nuclear power than to burn petroleum or natural gas. The actual cost of producing petroleum and natural gas is well below the price necessary to discourage its use and encourage the substitution of electric energy. Foreign sources of petroleum have already placed large taxes on the crude oil which they export. These prices have risen to the point where it has become more economical to use electric energy which has been generated with nuclear power than to burn petroleum. The price of domestically produced oil must increase to the same price as imported oil for one reason: continued domestic production. At the present time, the price of oil pumped from high production, existing wells in the United States has been controlled by the government at a price which is less than half the going world price. Oil production from new weils in the U.S. is allowed to sell at current world market prices so as to encourage exploration and new production. This is required because no oil company would choose to explore for new oil within the U.S. if it could receive

Non-Fossil Energy Sources of the World

Non-Depletable (Per-Year Basis)	
Geothermal Energy	0.009 Q
Wind Energy	0.003 Q
Tidal Energy	0.09 Q
Solar Energy	5,190. Q
Depletable	
Fission Reactor (Including Breeder-Type	420,000. Q
Nuclear Fusion (D_2 from Oceans)	10,000,000,000. Q
(World Energy Consumption Rate in Year 2000 = 1Q)	



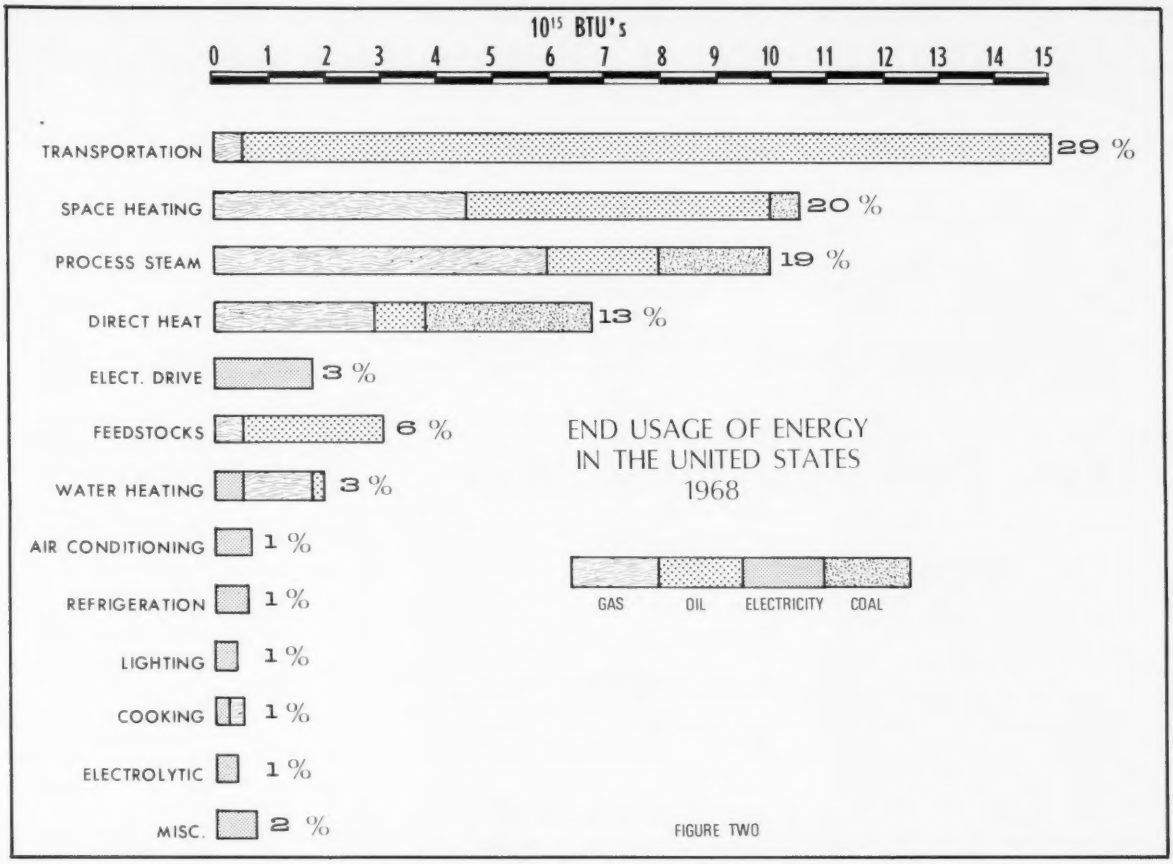

10^{15} BTU's
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TRANSPORTATION 29 %
SPACE HEATING 20 %
PROCESS STEAM 19 %
DIRECT HEAT 13 %
ELECT. DRIVE 3 %
FEEDSTOCKS 6 %
WATER HEATING 3 %
AIR CONDITIONING 1 %
REFRIGERATION 1 %
LIGHTING 1 %
COOKING 1 %
ELECTROLYTIC 1 %
MISC. 2 %
END USAGE OF ENERGY
IN THE UNITED STATES
1968
GAS OIL ELECTRICITY COAL

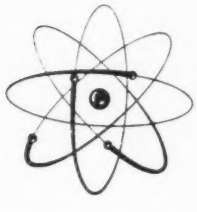
FIGURE TWO

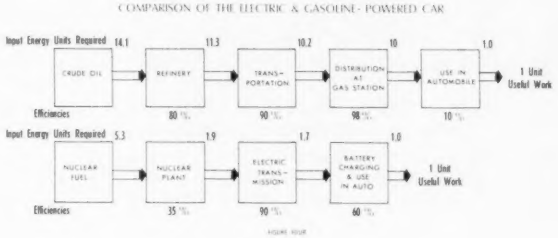
much greater prices for oil which it found outside the U.S. As the oil wells are depleted and new wells are brought into production within the U.S., the average price of oil and petroleum products within the U.S. will climb to equal the world price, and simple economics will force the substitution of electric energy which has been generated with coal or nuclear power.

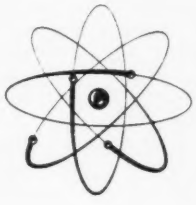
What this means to NAVFAC, as manager of the Navy's shore facilities, in the author's opinion, is that any new projects which are begun with an anticipated useful life of greater than 10 years, should be designed for use of electricity or ease of conversion to coal or electric energy in the future. As an example, electric heat pumps should be considered for all new family housing projects and other space heating and cooling requirements. The higher acquisition cost of the heat pump equipment and its associated electric distribution system could be offset by future operating expense savings. Ovens and ranges in galleys should be electric. All existing large heating plants should be converted to coal as clean-burning technology becomes available. Many other examples will occur to the reader.

In the transportation area, it can be expected that the Federal Government will be the leader in the use of electric powered vehicles. The post office will probably be the first major user of electric vehicles and DOD cannot be far behind. Within 10 years, the majority of passenger sedans and non-tactical light trucks acquired by the Navy could be electric powered.

In summary, the true impact of the present energy crisis is not the present, temporary shortages due to anomalies in distribution of petroleum, but in the future world shortages of supply which is presages. Out of our present crisis, must come the beginnings of the shift of the United States to a nuclear-electric energy economy. The author anticipates that the Federal Government, as the largest single consumer of energy in the United States, will assume the role of leader in the conversion of energy end uses to electricity.







the Trident System Support Site

By MARY ANNE EZZELL

• Alexandria, Va.

The Officer in Charge of Construction for the *Trident* support site has contracted with a joint venture of architectural-engineering firms to develop a preliminary master plan and environmental impact statement for the proposed location at the Bangor Annex of the Naval Torpedo Station, Keyport, Wash.

Approximately 500 architectural-engineering firms were reviewed before selection was made.

The contract, a joint venture, was awarded to Henningson, Durham, and Richardson, Inc., of Omaha and Washington; Parsons, Brinckerhoff, Quade, and Douglas, Inc., and Gibbs and Hill, Inc., of New York City. The Seattle based firms of Kramer, Chin, and Mayo, and Durham, Anderson, and Freed Co., are associated with the joint venture.

Henningson, Durham, and Richardson are primarily responsible for contract administration and are providing expertise, particularly in architecture and master planning. Kramer, Chin, and Mayo are serving as the resident coordinators of the special environmental studies for the preliminary master plan.

General objectives of the preliminary master plan are:

• Conduct reconnaissance surveys to develop a data base concerning the site and existing facilities and structures.

• Establish communications with local public planners, and community service organizations.

• Identify and analyze external influences within the region.

• Evaluate off-station transportation networks and recommend a program of improvements to that network for the operational requirements of *Trident*.

• Perform detailed ecological site investigations to develop a matrix of land uses and development intensities and to reduce adverse environmental impact.

• Utilize initial environmental conditions reports provided by the Civil Engineering Laboratory to minimize degradation of the environment.

• Implement explosive and industrial safety requirements and standards in developing land use relationships.

• Integrate relevant planning recommendations, guidelines and concepts developed through associated studies conducted by a wide variety of Navy commands. On the basis of data from the complex users, develop interior and exterior functional space requirements.

• Utilize data concerning operational and administrative relationships, equipment needs and services, and space requirements to define preliminary structure configurations and dimensions for all facilities.

• Recommend modes of transportation to be utilized within the *Trident* support site.

• Develop a utility master plan using area and facility utility requirements.

• Evolve alternative site development plans based on all known and projected land and facility needs from inputs furnished and to be furnished during the master planning process as well as those generated as a result of the master planning effort.

• Recommend construction procedures and building materials, architectural style and treatment for the *Trident* support site on the basis of studies of material availability, climate, and other pertinent factors.

• Analyze real estate utilization and total requirements as determined by the alternative land-use plans as dictated by explosives quantity/distance factors, functional area relationships, functional requirements, transportation and utility corridors, ecological factors and site encumbrances.

During the initial phase of the contract the joint venture gathered and analyzed social, ecological, and economic data and submitted a preliminary master plan and the draft of the environmental impact statement to the officer in charge of construction *Trident*. The *OICC Trident* reviewed the preliminary master plan prior to its presentation to the Naval Ordnance Systems Command, the Naval Ship Systems Command, and the *Trident* project manager. At the time of this writing the review and approval by CNO of the Preliminary Master Plan is anticipated. The draft of the environmental impact statement is now scheduled for review.

Following the necessary waiting period (at least 90 days) for public review and comment, the environmental impact statement will be finalized, printed, and distributed. Pending a minimum of one additional month waiting time after distribution the environmental impact statement will have completed its statutory time on file for acceptance by July 1974.

The final master planning effort will begin with contracts to be let in May 1974. That project will cover nine months work with completion of the final master plan contract and distribution of the document in January 1975.

There will be some $35 million in facilities built in support of the missile flight test operations at Cape Canaveral, Florida.

The Commander, Naval Facilities Engineering Command has tasked Captain Ernest R. Stacey as the Officer in Charge of Construction, TRIDENT, with full responsibility for the planning, programming, design and construction of the TRIDENT shore facilities.

Because of the geographic separation from the support site, the flight test facilities are under the management of the Southern Division, at Charleston, South Carolina. Preliminary planning and design for the facilities at Bangor began immediately upon announcement of the selection of that site in March 1973.

The first construction project, which is for the site clearing and foundation construction for a major training facility, was awarded in October 1974. The tempo of construction activity at the site will increase rapidly, and is projected to peak at about 3,600 workers.

Essential facilities are required to be completed to support the deployment of the first TRIDENT submarine in the fall of 1978.

2 WORDS

By EUGENE EARLY
Civil Engineering Laboratory

In times like these, when the volume of scientific and technical information doubles every five to seven years — and books and reports are out of date by the time they are printed — one is hard pressed to decide just what to read.

Concurrently, many new materials, processes and equipments are on the market. New construction and maintenance techniques are constantly being developed.

All these goodies are reported or described in sales literature that ends up on your desk of "things to read." Will these offer solutions to some of your current problems? Or are there other facts or fancies which would work better?

At this point, what you need is *help*. For your information — the R&D (research and development) community needs *help* too.

We try to identify field problems for NAVFAC's RDT&E program and can't find the people with the problems. We solve a problem, and someone says it was the wrong problem. Sometimes we get a good problem, and solve it, and then nobody seems to use the solution. Occasionally, we even end up with a solution looking for a problem!

What we both need — the people in the field with the problems and the people in the R&D community with the capability to solve problems — is a good dose of strong communication.

The most pressing need is for better two-way communication between NAVFAC, the EFDs, CEL, and field activities. In short, we need to talk to each other — more!

Person to Person Contact

The RDT&E liaison program is designed to transfer problems and solutions from and to field activities. At the EFD level an RDT & E liaison representative is the contact. Their names and telephone numbers are listed in the block for your information and *future use*. They listen and look for field problems that are suitable candidates for NAVFAC's R&D program and bring these to the attention of NAVFAC. This involves a fair amount of direct personal contact with NAVFAC R&D program people, the liaison reps in other EFDs, and people at CEL, the author included.

The liaison representatives are also responsible for getting R&D "know how" and technical data to the people in the field who need it. This also involves a variety of communicaitons, but between the EFD, CEL, and the field activities. These representatives are also always interested in your innovative solutions to problems which would be useful to others. (NAVFAC and CEL are too, for that matter.) If you have any technical problems for which you have found a good economical solution plus any which you haven't solved, give the man in your area a call — he is ready to talk "shop".

Under the RDT&E assistance program, CEL personnel provide quick-response assistance to personnel on field problems. CEL has the professional and technical capabilities to perform short-term controlled tests, analyses and studies of new materials, equipment, processes and construction and maintenance techniques.

RDT&E LIAISON REPRESENTATIVES

Ed Humm NORTHDIV Code 1028	A/V 443-4871
Tim Rohrer CHESDIV Code 032	A/V 288-4347
David Gurganus LANTDIV Code 09P2	A/V 690-1175
Al Byrd SOUTHDIV Code 90	A/V 794-3709
Walt Cowell WESTDIV Code 09PA	A/V 859-2549
Bill Young PACDIV Code 402	AC 808/471-3100

Plus, friends and associates in other organizaitons give an invaluable back-up resource. Available NAVFAC funding and the broad and varied expertise of the professional staff enable CEL to provide quick-response service — without cost — directly to the requesting activity. These services are being provided to EFDs, PWCs, PWOs, OICCs, ROICCs, and Civil Engineer Corps staff officers, everywhere.

CEL's Facilities Engineering Support Office provides a single point of contact and the author acts as the liaison person to get you a *prompt* answer. If you have a specific need, write or call us *anytime* (Autovon 360-4070 answers 24 hours a day).

Information Transfer

Improved information transfer can ease your paperwork burden by making the process of search more accurate and less time consuming; by decreasing the volume of non-pertinent information received; by providing information in a more usable format; and by assuring that the information is more up to date.

RAP Briefs (Research Applied to Public Works) furnish information on selected portions of CEL's current program that should be interesting and useful to engineers in the field. They provide an early awareness of work that is under way and include preliminary conclusions and results in advance of a complete report on the effort. This earlier awareness should lead to earlier use of the results — for improved solutions to field problems. Readers with specific related needs are encouraged to contact CEL investigators direct — and some do.

CEL Tech Data Sheets package the results and recommendations of CEL Technical Reports and Notes — the "how to" technical information and solutions to problems. Generally, two or four pages in length, written in plain language, with pictures, convey results you can put into practice. About 30 have been distributed in the last two years, with an increased output planned for the future. We are also working on other changes which should make them even more effective for you.

Now What?

If I had to close in two words, I'd say "let's talk". The people I've mentioned are part of an aggressive effort to provide improved services to you, the practicing engineer in the field. With your interest we can make this a team effort. We will keep pushing solutions your way in formats and styles we think will be most useful to you. And we'll keep trying to understand what your problems really are.

But help us help you. We need to know how well we are hitting the mark in satisfying your needs — *and when we miss completely*.

Let's talk — and soon.

Modern Facilities Planning To Include Total Energy Resources

It is a rarity for The Navy Civil Engineer to publish an article of this extent, however, the depth in which the Naval Sea Systems Command has gone in exploring all energy aspects of their ordnance installations is believed to be most noteworthy.

The Authors

CDR Paul H. Bradtmiller, CEC, USN, *Naval Sea Systems Command;* Donald A. Bartlett, *principal,* and Glenn D. Pusch, *associate — A. T. Kearney, Inc.;* Joseph J. O'Rourke, *senior project manager,* Alfred L. Leavitt, *senior staff analyst,* and Louis J. Caplan, *project engineer— The Ralph M. Parsons Company, Pasadena, Calif.*

How important is energy in facilities planning? What role does energy usage play and exactly how do you assess and evaluate its impact? These are questions that are being asked today in light of the international energy shortage.

The authors hope to describe a systematic approach designed to answer these questions and to provide the methodology necessary to include the evaluation of energy along with economic analyses and environmental assessments in the decision making process.

The Naval Sea Systems Command recently completed a major modernization study of selected ammunition production systems. The proposed modernization projects involve the consolidation or relocation of ordnance production systems among field activities, increased mechanization of production systems, upgrading of existing facilities, expansion of facilities or new construction to meet production requirements, and provision for improved safety and environmental enhancement.

Specifically, the proposed modernization involves fourteen systems for producing 59 ammunition end items at field activities which include: the Naval Ammunition Depots (NAD) at McAlester, Okla.; Crane, Ind.; and Hawthorne, Nev.; the Naval Ordnance Station, Indian Head, Md. and the Naval Weapon Station, Yorktown, Va.

The energy shortage occurred during the latter stages of the study after the modernization concepts for the production systems were defined. As a result, the study team reviewed the energy conservation guidelines of the Department of Defense to insure that specific measures were incorporated into the proposed modernization projects.

Based on the emphasis of energy conservation NAVSEA recognized the need to perform a quantitative energy usage analysis on the fourteen ordnance production facilities for which modernization was proposed.

The objectives of the study were: *Phase 1.* Determine and compare the energy usage for existing and modernized ordnance facilities. *Phase 2.* Calculate the energy required to construct and activate each modernized system (transition energy). *Phase 3.* Develop energy planning factors which can be used as a tool in decision making associated with facilities investments.

Energy Comparison of Existing and Modernized Facilities

Indicated in Table 1 is the comparision of energy usage of modernized versus existing facilities for the production systems studied.

In assessing energy usage related to ordnance production facilities, the study team considered three major categories for which energy was to be measured. The categories were: production system; support system; and transportation system.

Displayed in Table 2 is the energy usage by category for the 14 proposed modernized facilities.

The production system category includes energy related to equipment necessary to produce the specific ordnance end item. In addition, this category also included material handling devices such as powered conveyors, forklifts and pallet movers.

The support system category consists of the facilities and all equipment within the facility necessary to sustain its operation. Air conditioning, heating and lighting are examples of typical items in the support category.

The transportation system category consists of three subcategories:

• *Outbound Transportation* or the energy required to ship completed rounds from the field activity to an east and west coast outloading point;

• *Intra System* energy or that energy required to transport ordnance end items in process between production buildings on-site;

• *Personnel Transportation* or the energy attributable to the commuting of employees to and from the field activity. Energy usage for transportation of inbound materials and components was not assessed since this system or network was not included in the modernization study. Once the major categories were selected, the next step in the general methodology was to determine what unit of measure would be considered. For example, in each of the three categories there are various forms of energy used such as kilowatts per hour for lighting, horsepower for electric motors, standard cubic feet per minute for air and British Thermal Units (BTU) for heating. In order to make a valid comparison of existing and modernized systems, each form of energy needed to be converted to a common unit of measure. For purposes of the study, the BTU was selected as the common "energy unit."

Table 1

MODERNIZATION STUDY
NAVAL ORDNANCE FIELD ACTIVITIES

COMPARISON OF ESTIMATED ENERGY USAGE
MODERNIZED VERSUS EXISTING FACILITIES

System/Field Activity	BTU/End-Item Unit	
	Modernized	Existing
5″ Proj., Ill.,/Crane W.P., Chaff	56,297	79,847
V. T. Fuze, Booster/Crane	11,039	14,132
Rockeye Cluster Bomb•Crane	1.8×10^5	2.2×10^5
A/C Para Flare/Crane	56,878	78,497
5″ Proj. HE and Inert/Crane	66,227	97,324
5″ Prop. Charge/McAlester	27,961	30,141
40 MM Cartridge/McAlester	2,384	3,279
20 MM Cartridge/McAlester	1,512	2,070
2.75 Rocket/McAlester	18,704	18,801
Warhead, Melt Cast/Yorktown	465,108	414,737
PBX Cast Cure/Yorktown	637,362	954,363
Extruded Grains/Indian Head	39,711	180,000
Cast Rocket/Indian Head Motors	619,449	4.7×10^5
Warhead, Melt Cast/Hawthorne	1.0×10^5	954,000

The detailed methodology required to assess and convert energy in the three categories was developed for each category. The calculations of energy usage in the aforementioned categories involve the consideration of a number of variables for each production system and field activitiy. The major variables include the following: location of the field activity; location of the coastal outloading points; production rates and shift configuration; number and condition of buildings and production process and materials handling system design.

Production System

The NAVSEA modernization study provided detailed equipment lists and operational descriptions for each end item within a production system. This information includes specifications of horsepower, electrical and air requirements for proposed production equipment.

Since most of the production systems have capabilities to produce more than one end item, some end items are not sequenced to every station in the system or line. Accordingly, each end item was tracked through its operations and the energy related to the production equipment for each operation was computed. Where multiple buildings were involved in a production system energy was computed by building and then totaled for the system.

The analysis was performed on both the modernized and existing system configurations and comparisons were developed. The production quantities for each end item were used to develop a weighted average of BTUs per unit for each production system.

Support System

In calculating the energy usage for buildings and support equipment, basic data specific to each ordnance system was required. The geographical location of the field activity determined how many months a year on the average the buildings must be heated and how many days per year cooling was required. The specified production rate per shift of operation to meet mobilization requirements dictates how many shifts per month or per year the building must be in operation. The criteria developed in the modernization study specify the lighting levels for operational areas and non-operational areas for each building.

Once this type of data was known, an analysis of each building within a production facility was made. The study team's decision to assess energy on a building-by-building basis was predicated on the fact that each building has varying types of support equipment and therefore different energy requirements. Analyzing each building in the existing system and in the modernized system concepts provides a comparison of the support system energy requirements for each ordnance system in terms of BTUs per unit or end item of production.

Continued on next page

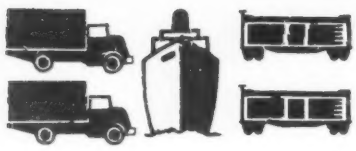
Table 2

MODERNIZATION STUDY
NAVAL ORDNANCE FIELD ACTIVITIES

ESTIMATED ENERGY USAGE BY CATEGORY
FOR MODERNIZED FACILITIES

System/Field Activity	BTU/End-Item Unit			
	Production	Support	Personnel	Outbound
5″ Proj., Ill.,/Crane W.P., Chaff	2,930	6,078	10,416	36,873
V. T. Fuze, Booster/Crane	453	903	2,280	7,403
Rockeye Cluster Bomb/Crane	462,706	71,104	217,546	1.1×10^5
A/C Para Flare/Crane	1,896	14,981	21,495	18,506
5″ Proj. HE and Inert/Crane	8,152	6,361	14,161	37,553
5″ Prop. Charge/McAlester	838	605	1,316	25,202
40 MM Cartridge/McAlester	727	581	589	488
20 MM Cartridge/McAlester	310	516	239	446
2.75 Rocket/McAlester	197	1,373	2,259	14,875
Warhead, Melt Cast/Yorktown	355,768	82,040	15,495	11,803
PBX Cast Cure/Yorktown	77,251	226,250	91,774	242,087
Extruded Grains/Indian Head	4,840	17,287	10,418	7,166
Cast Rocket/Indian Head Motors	68,341	200,460	261,740	88,908
Warhead, Melt Cast/Hawthorne	835,215	126,723	17,652	52,886

Note: Intra-system transportation energy usage is included in production energy.



Transportation System

As previously indicated, there were three sub-categories in the transportation category: intra system, outbound and personnel. Let's review the methodology used in each of these sub-categories.

To compute the energy attributable to *outbound transportation*, several items of data are required. First, the quantity of each end item to be shipped to the east and west coast outloading points must be known. Second, the method of transportation such as rail, truck or barge is required. Third, the shipping weight of each ordnance end item and the distance from the producing field activity to each outloading point must be determined.

The goal in processing these data is to develop transportation miles for each ordnance end item. The Rand Corporation has developed data relating to BTUs per ton mile for rail, truck and water transportation. Using the Rand data along with computed ton miles for each ordnance end item, an assessment of BTUs per end item for outbound transportation was generated.

Intra system transportation occurs when in-process transporting of end items between buildings is required. It does not include conveyor transport since that phase is included in the *production system* energy evaluation. It does include on-site truck transport, however. An analysis of the end item production quantities and the operational description of the process yields the quantities of each end item which must be transported between buildings on a shift basis.

This data coupled with an estimate of the typical vehicle size, mileage per gallon of gasoline for that vehicle, quantities per load, and a conversion value for BTUs per gallon of gasoline yields the BTUs per end item required for *intrasystem transportation.*

The personnel transportation sub-category is directly dependent upon the field activity location and the number of people required to operate the existing and modernized production systems.

To develop this data, the study team requested information from each field activity describing the average round trip distance traveled daily to and from the activity and car pool data describing the average number of people per vehicle.

From the data supplied by each activity and from manning tables for both the existing and modernized ordnance production systems, the study team developed the number of vehicle trips required to support the operation of each system. Utilizing the conversion value for BTUs per gallon of gasoline (132,000) and an estimated average miles per gallon (12), a determination of BTUs per man shift for each field activity was calculated. (See Table 3).

Table 3

Personnel Travel Data

Field Activity	Average Daily Miles	Average Men/Car	BTU/Man-Shift
NAD Crane	46.8	1.99	259,000
NAD McAlester	22	1.84	132,000
NWS Seal Beach	26	3	95,400
NOS Indian Head	51.4	1.73	326,000
NAD Hawthorne	10	2	55,000
NWS Yorktown	38	4	105,000
Average			162,000

Assumptions: Average of 12 miles/gallon/car gasoline energy content — 132,000 BTU/gallon.

Synthesizing Data

To compare existing and modernized systems, the task involved preparing system averages for the major energy categories of production support, and transportation. Taking the end item BTUs in each category and considering the mobilizing production quantities, we computed weighted averages for each production system. The weighted system averages for each category were compared in total to determine the net effect of modernization in terms of energy usage. Figure 1 shows an example of a computerized summary of the 5″ propelling charge existing and modernized systems at the Naval Ammunition Depot (NAD) at McAlester, Okla.

Phase II — Transition Energy

The second phase of the study was to determine the energy required to implement each of the fourteen modernization projects. This energy, termed "transition", is a one-time energy expenditure during a specified time period.

Utilizing the knowledge gained in determining energy requirements to operate the facilities, the study team established three sub-categories of transition energy. The sub-categories were: construction; personnel; and equipment delivery.

Let's look at each one in greater detail.

Construction

The *construction category* included energy associated with the actual construction tasks. It includes gasoline and/or diesel fuel required for equipment and vehicle operation and electrical power required over the construction and facility activation period.

The Ralph M. Parsons Company recently completed an energy study concerned with quantifying construction energy (BTU's) for several standard industrial code classifications. The study included determination of energy for projects of from one million to 100 million dollars of construction costs, broken down into the various activities typical to a construction effort.

The authors utilized the results of this study along with the constructed value of each of the modernized NAVSEA facilities to develop the construction energy requirements over the transition period.

Of the total cost of construction, it can be estimated that approximately 50% of that cost will be devoted to labor and 50% to material for new construction. Where the project is primarily modification to existing structure as opposed to new construction, about 60% of the construction value will be labor. Using this experience factor along with the detailed description of each modernization project, the study team determined the total dollars attributable to labor for each project. Then, estimating the

Figure 1

ENERGY ASSESSMENT ANALYSIS

SUMMARY

5 INCH PROPELLING CHARGE

FIELD ACTIVITIES
Modernized — **McAlester**

Existing — **Crane, McAlester, Seal Beach**

End Item	Units/month
2 5 inch/38 reduced	4200
3 5 inch/38 full	138000
18 5 inch/54 full	93000
19 5 inch/54 reduced	2600

MODERNIZED-BTU/UNIT

Item	Support	Production	Outbound	Personnel	Total
2	605.105	838	19762.5	1244.05	22449.7
3	605.105	838	24182.2	1309.52	26934.8
18	605.105	838	27071.4	1331.35	29845.8
19	605.105	838	21236.5	1265.87	23945.5
SYSTEM	605.105	838	25201.8	1316.43	27961.4

EXISTING-BTU/UNIT

Item	Support	Production	Outbound	Personnel	Total
2	4900.32	1907	9605.	5582.71	21995.
3	7463.37	1908	15324.9	3559.77	28256.
18	9823.36	1907	14558.	7154.35	33442.7
19	6449.29	1907	9886.15	7002.75	25245.2
SYSTEM	8329.97	1907.58	14864.5	5038.93	30141.

number of days involved in construction and activation for each system and developing an average wage rate for construction labor, the total number of people required to perform the project over a specific time frame was calculated.

Assuming that the construction crew will travel to and from the site just as the ordnance worker does, the BTUs per man per shift factor for each activity was applied to the construction labor personnel to determine personnel transportation energy requirements over the construction and activation period.

Equipment Delivery

Since our previous analyses indicated that transportation energy usage was such a significant factor in total energy requirements, the study team concluded that the fuel required to transport the production equipment necessary for implementation of the modernized systems should be included in *transition energy*.

To obtain this fuel energy usage, a determination of equipment weight, distance from supplier to field activity and method of transportation was required in order to obtain ton-miles of transportation. The weight of production equipment from each modernized system equipment list was estimated and a typical supply source was selected from those provided in the modernization study report distance from the vendor's location to the activity was determined from a rail atlas. The assumption was made that rail would be the mode of transportation; however, truck could have just as easily been used. Applying the Rand Corporation BTU/ton mile for rail transport resulted in the energy requirement for equipment delivery.

The data developed thus far for *transition energy* was in terms of total energy for the project. The study team also developed time phased data for the energy usage of the three transition categories on a daily and cumulative basis during the project implementation period.

As was previously stated, transition energy can be considered as that energy which has a definite beginning point (start of construction) and a definite completion (end of facility activation period). Between these points there is a build-up of energy to a peak and a corresponding decline as the project nears completion.

In normal practice it is estimated that about 70% of the total project can be considered in the construction phase, while 30% is taken up by activation of the new system. The study team assumed that labor would be expanded in the same proportions; hence, 70% of the construction energy and 70% of the personnel energy usage would occur over 70% of the estimated days to complete the total project.

It was also estimated that equipment delivery would occur during a period between 50% and 70% of the elapsed days of project duration. This selection was totally arbitrary and could have fallen between any two points selected.

A computer was utilized to develop the plot points for the curves. Graphical displays of transition energy for construction and personnel categories for each modernization project were then developed. The energy attributable to equipment delivery, being much less significant, was not graphed on a daily basis but was included in the cumulative plot of transition energy. (Figure 2 shows the daily transition energy plots for the modernization of the 5″ propelling charge system at NAD McAlester. Figure 3 shows the cumulative curves for the same system. Table 4 summarizes the transition energy associated with the 14 modernized ordnance systems.)

The third and final phase of the study was the development of energy planning factors which would be utilized in the selection of alternatives for facilities planning or for assessing energy requirements related to a particular investment.

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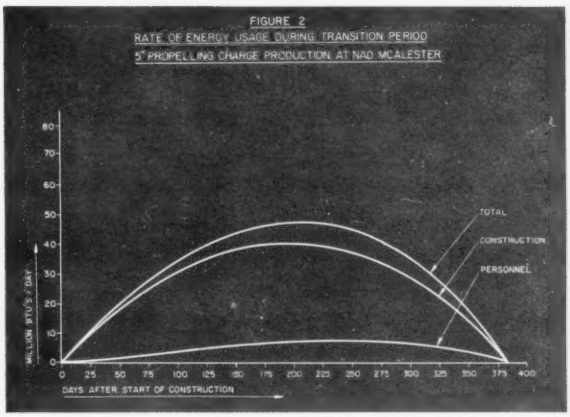


Modern Facilities Planning

To Include

Total Energy Resources

(Continued from preceding page)

Phase III — Development of Planning Factors

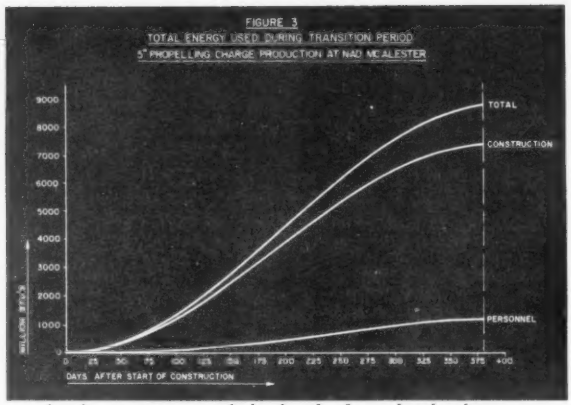
To develop planning factors, the data compiled in the two previous study phases were analyzed to determine what relationships with known variables, if any, were present. The study team isolated those relationships and developed the following specific *energy planning factors*:

Category	Planning Factor
Production System	100 or 530 BTU/Lb. of end product
Process Energy	1,000 BTU/Lb. of end product
Support System	15 BTU/ft.^{3}/Shift
Outbound Transportation	300 BTU/Lb. of end product — Rail 960 BTU/Lb. of end product — Truck 200 BTU/Lb. of end product — Water
Personnel Transportation	162,000 BTU/Man/Shift
Transition Energy	6,748 BTU/Construction Dollar

Derivation of the Planning Factors

Each of the planning factors was developed from the energy analyses of the 59 ordnance end items included in this study and the evaluation of transition energy for each modernized ordnance system. Specifically, the *support system planning factor* was computed based on the arithmetic average of support system energy required per shift for each end item. The range in support systems BTUs for the various end items was minimal such that the average of 15 BTU/ft^3 shift is an acceptable factor.

The *production system planning factor* required more analysis to determine a range from which to choose a factor. We found a wide range of BTU/unit or end item for production energy. This variation was apparently caused by a number of factors including: end item weight and configuration; production process; complexity of the production process; and the level of mechanization.



To reduce the data to a more reasonable range, the study considered a product weight factor and converted BTUs/end item to BTUs/pound of production. This narrowed the range but it was still unreasonable in terms of selecting a planning factor. Further study produced the fact that the high range of values were those end items for which steam was involved in the process. This "process energy" or that energy which is required to perform some chemical change in the product, was removed from those end items and the range narrowed considerably.

A further examination of the data at this point led to the conclusion that there were two distinct categories of end items. The first category which comprised 45 of the 59 end items were those characterized by either a low level of system mechanization or mechanization of a non-complex nature. A mean value of 100 BTU/pound was calculated for this category. The remaining 14 end items were characterized by complex and highly mechanized production operations. The end items in this category had a mean value of 530 BTU/pound.

Preliminary production energy usage determinations are greatly simplified through the use of the two planning factors since the analyst need only determine the weight of the product and item and within which production category his proposed system falls.

Process energy, as used in this study, is defined as that energy which creates some chemical change in the end items. In this study, the primary contributor to process energy was steam. In those end items where steam is an

Table 4

NAVAL SEA SYSTEMS COMMAND
MODERNIZATION STUDY

NAVAL ORDNANCE FIELD ACTIVITIES
TRANSITION ENERGY SUMMARY

End-Item	Scheduled Days	Construction Dollars	BTUs of Energy	BTUs/ Construction Dollars
Warhead (Hawthorne)	240	$ 930,000	$.54 \times 10^{10}$	5,800
Warhead (Yorktown)	240	730,000	$.45 \times 10^{10}$	6,164
PBX	240	1,145,000	1.3×10^{10}	6,061
Cast Rocket Motor	350	10,950,000	7.4×10^{10}	6,758
Extruded Grain	570	11,317,000	7.6×10^{10}	6,716
Parachute Flares	360	1,900,000	1.32×10^{10}	6,947
5" Projectile	420	5,940,000	3.89×10^{10}	6,549
Rockeye Cluster Bomb	450	4,810,000	3.19×10^{10}	6,632
VT Fuse	300	338,000	$.25 \times 10^{10}$	7,396
5" Ill., W.P., and Chaff	300	527,000	$.39 \times 10^{10}$	7,400
5" Propelling Charge	360	1,410,000	$.88 \times 10^{10}$	6,241
20 MM Cartridges	300	1,300,000	$.83 \times 10^{10}$	6,385
40 MM Cartridges	360	2,130,000	1.30×10^{10}	6,103
2.75" Rocket	300	700,500	$.44 \times 10^{10}$	6,276
Totals		$44,127,500	29.78×10^{10}	
Formula			$\frac{29.78 \times 10^{10}}{44,127,500}$	
Use: BTU/Construction Dollars	6,748			

integral part of the process such as in warhead melt cast loading, the energy attributable to steam is greatly in excess of other forms of production energy related to the end item. For this reason, steam or process energy was considered as an entity in itself and was removed from the production system energy in the determination of the planning factors.

The average of those end items which require steam was approximately 1,000 BTU/pound of end item weight.

The *outbound transportation planning factor* is a very preliminary number and was derived for use only when no specific facility location(s) have been determined. Once potential locations have been determined, actual distances and quantities can be substituted. The planning factor is based on shipping equal quantities from one centrally located field activity to the east and west coast outloading points by rail. Similar factors have been computed for truck and waterborne methods of transportation.

The *personnel planning factor* is an arithmetic average of the BTU/man/shift computed for each field activity. (See Table 3.)

The *transition energy planning factor* was based on the following:

	Minimum	Maximum
Construction Cost	**$300 M**	**$11.3 Mil**
Total Estimated Construction Days	**240**	**570**
BTU's/Construction $	**5800**	**7400**
MEAN BTU's/Construction $	**6748**	

The table shows wide ranges in both construction costs and length of construction periods. However, when analyzing the data for each of the fourteen modernized projects, the study team found a narrow range in BTUs/construction dollar. The mean value of 6748 BTUs/construction dollar becomes the transition factor.

Utilizing the Factors

The planning factor logic diagram (Figure 4), describes how the factors can be used in assessment of energy requirements. As was noted in the derivation, the planning factors are in most cases, preliminary numbers and should be utilized when assessing energy based on an initial facility concept. As the concept becomes more defined, the planning factors can be replaced with more refined data which reflect the extent of concept definition.

As the diagram indicates, application of the planning factors to the initial configuration provides categories of energy and finally an assessment of total energy attributable to that configuration. As the concept becomes more defined, so does the energy assessment.

Energy Planning Factor Application

Now that energy planning factors are recognized for the major categories of energy usage in load and assemble ordnance operations, what are some of the potential uses of these factors?

(1) Site Selection

Transportation is one of the highest energy users; it, therefore, becomes a significant factor in site considerations.

If production of a new end item is under consideration, alternate production sites can be evaluated in terms of energy usage and resources based on the production requirements and coastal outloading points. Other things being equal, those sites with the lowest transportation energy requirements would be prime candidates for further evaluation.

Similarly, if an end item is produced at several sites, a consolidation to one or two locations may result in an overall energy reduction as well as a production cost reduction. Accordingly, an energy assessment should be conducted in conjunction with a consolidation or modernization program.

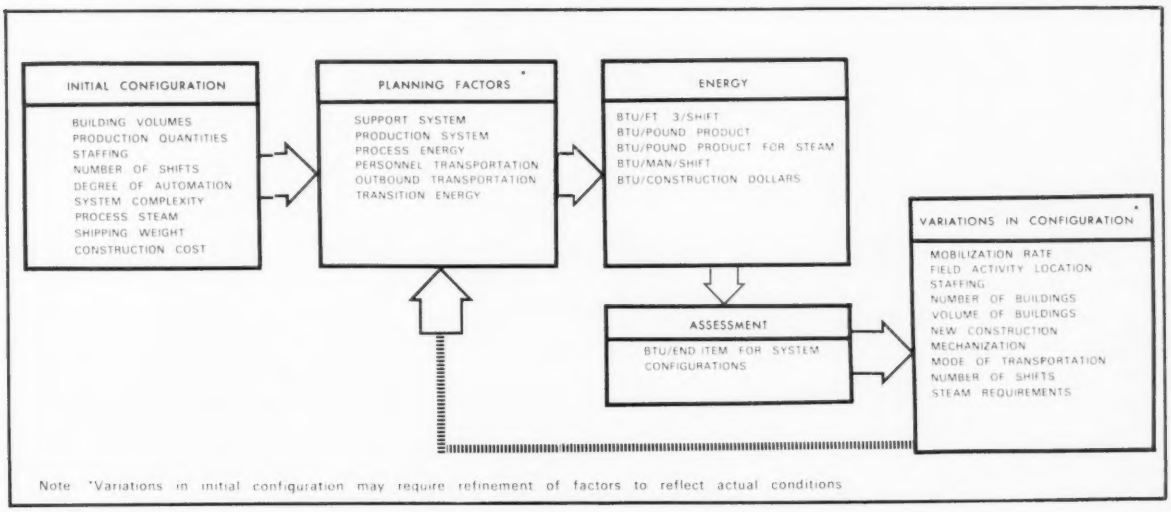
Another consideration is the availability of energy resources. The concepts for a proposed production system can be quickly evaluated for energy requirements using the planning factors to estimate the gross impact at the location under consideration. Each area can be evaluated to determine if local energy resources are capable of meeting any increased demand that would be imposed on the local energy producers.

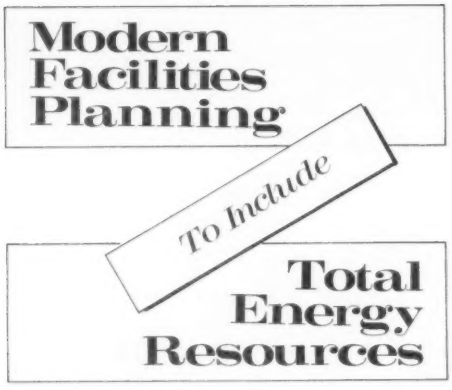
(2) Scheduling of Projects

Again, the major contributing energy factor is transportation. If several major projects are under consideration, the projects could be scheduled to level the energy impact on the metropolitan area by staggering the projects to level out peak demands on energy resources. Indirectly, physical distribution problems would be minimized in this leveling process by reducing peak amount of traffic into the area as well as demands for fuel.

(3) Production System Evaluation

Production energy requirements vary inversely with personnel transportation energy as the level of mechanization





becomes more intensive. For instance, if automated or highly mechanized handling procedures were installed, there would be a reduction in the number of operating people required. Even though the increased mechanization consumes more energy, the reduction in line personnel, resulting in a decrease in transportation energy, may more than offset the production energy decrease.

(4) Facilities Design

Since the Support System Planning Factor is building volume related, it can be used to compare an existing system with an upgraded and/or modernized system to determine which alternative requires the least energy. For example — an existing system requires several buildings to produce an end item. Consolidation of the operations into fewer buildings will result in lower support system energy expenditures. Similarly, a new structure, designed specifically for the production system may incorporate other energy conservation features that would further reduce the energy requirements.

If a substantial increase in production is required, necessitating construction of new facilities, the planning factors could be used to quickly assess the energy impact and may indicate that the additional production should be at an alternate location.

(5) Transportation

Currently, the primary mode of outbound transportation is rail and truck. Since waterborne transportation requires 33% less energy per ton-mile, it may be beneficial to consider siting a facility near waterborne facilities or use combinations of truck and rail in conjunction with waterborne carriers.

Study Implications

With the advent of the energy crisis, *it is very probable that an energy assessment may become just as important as an economic analysis and environmental assessment* in the decision making process. The planning factors provide a means to assess energy related to each iteration of a concept in the same way that cost and environmental effects are assessed.

Considerations such as the significance of methods of transportation, conservation techniques such as building insulation, and the utilization of existing structures versus new energy conservative structures are now of more importance.

The utilization of energy in an economical manner will be a primary concern for anyone involved with system design, equipment selection, siting and facility design for practically any type of facilities project. This study, although specific to ordnance manufacturing, has demonstrated a methodology which is certainly applicable to other operations.

ON ADVICE OF COUNSEL

By WILLIAM H. SPECK

How can the Government ever pay contract moneys to the wrong party? Answer, too easily.

Almost always contract payments properly go to the contractor named in the contract, by check mailed to the address set forth in the contract. Exceptions arise for assignments, novation agreements, and court orders. Court orders to pay another rarely occur, because Government funds are not subject to garnishment or attachment but orders to pay trustees for bankrupts or corporations in reorganization do occur and must be obeyed. Novation agreements for changes of name, mergers, consolidations, etc. (ASPR 26-400 ff.) require much paperwork support and expressly validate previous payment so they rarely result in wrong payment.

But financial institutions advancing funds on the security of assigned contracts become entitled to contract payments upon filing proper notice of the assignment with the contracting officer and surety. A payment to the contractor after proper notice of assignment is not a discharge and may have to be paid again. BUDOCKS once got caught making payment to the contractor by a disbursing officer after an assignment notice had been received by the contracting office, and the Government paid again.

Creditors of contractors cannot be paid contract proceeds, though the U. S. Supreme Court says the Government has a kind of moral obligation to see them paid and though the Court of Claims recently, denying jurisdiction itself, wanted the Navy voluntarily to pay.

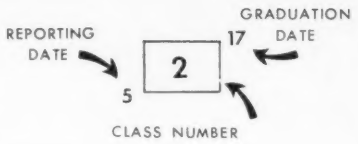
On construction contracts creditors are paid by Payment bond sureties, and these are the most fertile sources of wrong payment. Upon notice from a surety (perhaps even only by telephone) that it is in receipt of claims from unpaid creditors, and asking that the Government pay contract proceeds to the surety or at least cease paying to the contractor, the contracting officer must cease payments to the contractor or assignee. The surety need not allege that it has paid any claims whatsoever, let alone have paid to the extent of its bond penalty.

The Government as a mere stakeholder having no claim on the proceeds itself can pay no one except at its own risk and must hold the proceeds until a court has determined entitlement to the money. The Government is a mere stakeholder when performance has been completed but moneys remain in its hands from retentions, earned but unpaid progress payments, deductions for defective work or labor violations since corrected, etc. If the Government is more than a mere stakeholder because performance has not been completed, the Government may continue progress payments to assure completion, if payment is the prudent course and appropriate steps are taken to assure that the moneys go to pay for contract work.

The Comptroller General forbids payment to an entitled surety except in rare instances where years after completion of work the contractor has disappeared, the surety has paid all claims and indemnifies. The contracting officer may with the contractor's consent send the payment check to an address acceptable to the contractor and surety, usually a bank which applies the proceeds as the parties have agreed. ASPR 18-618.3(b). But in one recent case involving such an agreement, an unscrupulous contractor personally interpreted the check before mailing, and the United States was liable to the surety by paying the wrong party.

NAVAL SCHOOL, CIVIL ENGINEER CORPS OFFICERS PORT HUENEME, CALIFORNIA

COURSE SCHEDULE FISCAL YEAR 1975



COURSE	MONDAYS	JAN				FEB				MAR					APR				MAY				JUN					JUL			
		6	13	20	27	3	10	17	24	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30	7	14	21	28
Basic CEC		2	134							28					9	135								6							
Public Works Mgmt						3	82			28	17	83		28					12	84			6	16	85		27				
Contract Admin						3	82			15	17	83		28					12	84			6	16	85		27				
Seabee Operations						3	62			28	17	63		28					12	64			6	16	65		27				
Military Justice								3	23	7											9	24			13						
Group VIII E8/E9														3	20			16													
Group VIII E6/E7				20	5					28									19	6							27				
Refresher Inst								3	7	14																					
Shore Facility Plan		6	57	17											14	58	25						16	59		20					
Economic Analysis						24	20	28						7	21	11							9	22		13					
Construction Mgmt		6	6	17										7	7	18															
Ocean Engineering															21	16	2														
Network Analysis															28	32	2														
Const Contract Neg															5	22	9														
Navy Indust Fund													31	60	4																
AICUZ Familiar						12	6	13	*																						
Environmental Prot		27	3	30											7	4	10														
Energy Mgmt			20	3	22											28	4	30													
PCO/PXO	SCHEDULED AS REQUIRED																														

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Lab Developed Universal Connection Brings About . . .

A BOON FOR BOOMS

To successfully contain an oil spill, speed and efficiency in the use of mechanical booms are essential. But that is difficult to achieve when commercial booms come in various sizes with different inter-connecting devices.

The Civil Engineering Laboratory (CEL), Naval Construction Battalion Center, Port Hueneme, Calif., has solved the logistical shortcoming with the development of a universal boom connector. It allows sections of different types and sizes of booms to be quickly and effectively connected.

The Navy has accepted the CEL connector design as standard hardware for all new booms. And the Naval Facilities Engineering Command (NAVFAC), sponsor of the CEL program, has decided that future boom purchases from all manufacturers must be fitted with the universal connector. Presently, approximately 200 firms are in the business of making oil-containment booms.

Recently a NAVFAC order for 15 booms specified that the new connector be written into the contract.

One leading manufacturer of mechanical booms has endorsed the connector "as a universal type piece of equipment." The company said it is converting its entire system over to the CEL design. "We have found it extremely functional, lightweight, inexpensive, and most important, simple to use. Hopefully, all manufacturers of booming equipment will eventually adapt this design."

Since the Navy holds the patent on the invention it will save considerable money in terms of royalties not paid out by the government.

Developed by Frank Campbell and Doug Graham, CEL mechanical engineers, the connector design had to comply with restrictions imposed on boom assemblies by hydrodynamic forces during containment operations. The connector had to meet the following characteristics (1) Insensitivity to decoupling when subjected to surge and heavy forces in the field; (2) Easy attachment by personnel from small craft; (3) Rotational flexibility to reduce bending loads in bidirectional tidal currents; and (4) Fabrication materials resistant to marine corrosion and with high strength.

The Laboratory concept consists of extruded aluminum male and female connectors configured for simple attachment to the needs of presently available boom sections. Campbell said two booms can easily be connected by two men working out of a small boat in less than one minute, even in rough seas, because the set of connectors doesn't have to be carefully aligned before interconnection.

CEL was able to fully meet NAVFAC requirements for hardware design, field testing and recommended contract specifications within nine months. Meeting this deadline enabled NAVFAC to include the connector in its latest oil spill containment boom procurement program.

It is hoped that a Federal Stock Number will be assigned to the device so that when a Public Works director decides to retrofit existing multi-sized booms he can simply order the universal CEL connector.

The connector is attached to the boom end by a metal plate and bolts. A rod (flexible or rigid) runs the full height of the boom to assist in keeping the connector attached to the boom under tensile loads.

After testing and evaluating several design proposals, engineers selected a tubular assembly as the basic unit for the connector component. Its advantages included insensitivity to decoupling and rotational flexibility.

Aluminum alloy was selected because of its high strength/weight and good extrusion properties. The connector is strong enough to withstand operational forces yet is light and requires no buoyancy. Extrusions are cut to fit the overall height of each type of boom and all corners in contact with the boom end are rounded to minimize abrasion.

The female connector tapers outward and upward to a wider diameter at the top to allow insertion of the male connector without the time-consumming need to align the two in a vertical or near-vertical position.

If the female and male connectors are pulled apart, sufficient elasticity remains in the jaws of the female segment to allow reuse. A small retaining pin prevents excessive relative vertical motion of two sections. A Dacron line is attached to the top of each connector, making it easier to lift from the water when joining booms.

Prototypes of the boom connector were subjected to an accelerated series of laboratory and ocean tests under the direction of Richard C. Towne, a senior project engineer at CEL. The tests were designed to establish the adequacy of prototype standardized boom hardware for its intended use and to verify the assumptions included in the design of the hardware. Laboratory tests determined the strength of the connectors and simulated conditions under which oil leakage could occur. Ocean tests simulated force loadings and handling situations that would be encountered during actual operations. Thus, any necessary modifications to the connector assemblies were implemented before the equipment was put into service.

In harbor tests, a connector prototype was tested for ease of connecting two three-foot boom sections. Two men in a small boat were able to join the sections in 30 seconds.

In open sea tests, boom sections were joined by each connector to form a 1,000-foot barricade which was towed to sea in a straight line. A second boat attached a line to the free end of the boom-towing assembly and formed a catenary with the other boat. The connectors held the barrier together without incident.

Realizing the present lack of applied research and development of new procedures and hardware, the Navy continues to develop its own oil spill cleanup technology/capability.

CEL said efforts will be made to extend the use of the connector to other federal agencies and commercial users to reduce procurement costs and to prevent equipment incompatibility when various agencies join forces to combat a future oil spill.

Books and Essays as viewed by

T. C. MURPHY
Director, Engineering Management Division CECOS

PANIC IN THE BOARDROOM, By William G. Capitman, Anchor Press Doubleday, Garden City, N.Y., 1973, $7.95.

In the last ten years, the American consumer has become more familiar with the face of The Corporation and learned, for the first time, that it is not as pretty as generally portrayed.

Even as late as the mid-60's the level of public confidence in business and its institutions was tilted in favor of business: but in less than a decade, the scale has become heavily weighted on the side of a "no confidence" vote.

What are the reasons for this shift?

All through the years of our history, many of our folk heroes were men from the business environment: men who by wit, wisdom, persistence, and courage, achieved great things so that people could live better, so that America would be stronger, and so that our way of life would be blessed with progress! Some of these "giants" were: Henry Ford, Marcus Hanna, Andrew Carnegie, John D. Rockefeller, and William Randolph Hearst, Senior. That magic word "progress" which united industry and science and spawned so many things which were new, and attractive, and "necessary"; and even though some of them were expensive burdens on the family budget, they were bought, and consumed, and replaced.

But in the last decade we have learned that many of the things were not biodegradable (a new word) and were cluttering up the landscape. We learned that the natural resources used to produce these things were in danger of being exhausted, and that we were becoming more and more dependent upon other nations, many of whom seemed anxious to capitalize upon our needs and wants. We learned that instead of being the most richly blessed of societies because of a century of unparalled progress we were possibly a horde of faceless, numbered, credit-card encumbered consumers engaged in an endless shopping spree, applauded constantly by the corporate voice, the advertising industry (a parasitic one, in this observer's belief) whose graduates, when placed in positions of high authority in governmental executive office, became principals of the nation's worst political scandals.

Today, the list of contemporary heroes begins with Ralph Nader, Barry Commoner, David and Kathy Marshall, et al. Business and its institutions are looked at with distrust by many, and generally listened to cynically. Americans, by and large, have concluded that corporations have no moral sense, are dedicated to profit *uber alles*, and that they are determined to contribute to environmental repair and protection and to social reconstruction, reluctantly, *only* what they are forced to do.

Further, in a consumer's view, because a government wheat sale to the Soviet Union (at bargain prices) resulted immediately in an increase in the cost of an American loaf of bread; and since Lewis Engman, Chairman of the Federal Trade Commission stated: "The fact of the matter is, that most regulated industries have become federal protectorates, living in the cozy world of cost-plus, safely protected from the ugly spectres of competition, efficiency, and innovation"; and further since the milk producers association who seemed to have enormous sums of money to cast upon the political waters as milk consumers watched the government-fixed price of milk go out of reach for many of them; there does *indeed* exist an un-holy government-business alliance, and that these consumers want to come in from the cold. And they are.

These well-publicized events, coming as they did soon after scores of like predecessor events, were cumulative, and catalytic. For many consumers, earlier suspicions were confirmed, in some cases as a result of direct experience. The scale was tipped.

Even though *Panic in the Boardroom* is only just begun, it will probably continue, and grow. Since the American worker / consumer / citizen has learned that he can stop a war, can drive a president from office, he is quite ready to take on business and its institutions.

No more *caveat emptor*. Let the producer beware.

This book is a comprehensive, scholarly (but very readable) unemotional treatment of how and why this new view of the corporation came about. As far as I can determine, it was not reviewed by *Fortune* or *Business Week*.

GRADUATE SCHOOLS FOR GENERALS, By Maureen Mylander, in the Washington Monthly, Issue of October 1974, pp. 42-52.

The National War College is one of five military schools for future admirals and generals. There is also an Army War College, a Naval War College, an Air War College, and an Industrial College of the Armed Forces.

What are these schools like? Who attends? What criterion is used in selecting students? What is the content of the curricula? What is the intellectual result?

The purpose of the National War College, the theoretical apex, is to enable promising senior officers an opportunity to think, to discourse, and to study strategic problems, opportunities, and alternatives so that (as a school catalog noted) they could "exercise a great influence on the formulation of national and foreign policy, in both peace and war".

This is certainly a lofty and worthy objective, but the article's author asserts that "it has produced no strategic thinker of any note since Admiral Alfred Thayer Mahan (c. 1890). Strategic writings and debates of the past twenty-five years, such as they have existed in military circles, have contained more description than analysis, more rancor and special pleading than systematic thought".

The author is probably right; but why is it so? The article offers some clues, some facts, some opinions. Some readers will see the article as biased; I suspect, however, that many senior military professionals share that same bias, for the same reasons.

YARDSTICKS OF EXPRESSION IN THE MILITARY ENVIRONMENT, By LT Dennis R. Neutze, JAGC, USN; in The Jag Journal, Spring 1973, pp. 180-203.

One of the many relics of the Vietnamese conflict is the continuing debate, too often casting much heat and little light, about the constitutional rights (their abrogation, violation of, etc.) of servicemen. This article is concerned with the right of free speech, and its limits, in military organizations. The judicial system has had much to say, and to decide, on this question throughout the 20th century; i.e., it is not a new question. This article reviews the subject, through many cases and many courts, both civil and military. It is written in language the layman can understand, it is readable and instructive for all military professionals, particularly for commanding (or prospective) officers.

New Tricks

HIGH ACCURACY of the automatic blade control system is displayed in this photograph. No groove exists after the motor grader made two passes over the area. If the blade angle control had been off a degree, a groove deeper than one inch, would have been cut.

The Navy and Marine Corps each year spend many millions of dollars to move billions of cubic yards of earth while digging, leveling and grading thousands of construction sites.

In terms of manhours, heavy equipment, materials and fuel, the total cost is not dirt cheap. In fact expenditures keep rising.

It behooves the Navy to develop surveying instruments and automatic controls to increase efficiency and speed of equipment operations, to decrease the number of personnel required, and to lessen training and experience of machine operators and thus reduce costs of moving earth.

Recently it took Seabees 5,000 manhours to construct a 30,000 square yard parking facility at an overseas installation; a comparatively small, routine assignment. Cost per manhour was $75 or approximately $375,000. That included travel, support logistics, wages, housing, etc. Fill material and asphalt covering were a separate expenditure of $1 million.

The development of semi-automated earthmoving equipment and surveying instruments is presently underway at the Civil Engineering Laboratory (CEL), Naval Construction Battalion Center, Port Hueneme, Calif., under the sponsorship of the Naval Facilities Engineering Command (NAVFAC).

CEL Program Manager Dr. C. J. Ward said that a future Seabee task could save possibly 50 percent in manhours (or about $180,000) if CEL innovations were used.

"If an earthmover equipped with automatic controls can function at optimum efficiency, the required fuel and project time will be reduced and the work output per equipment life would be increased," Ward said. "But the real benefits and cost savings would be gained through the automation of the heavy machines' more difficult functions so that they would be capable of producing quality work in less time despite the fact operators with less experience are at the wheel. It goes without saying that reducing time on the construction decreases the demands for supporting labor and materials."

CEL is developing and evaluating adaptive/automatic controls retrofit kits for the motor grader, scraper and bulldozer using modified laser construction surveying equipment. Preliminary studies and field tests indicate adaptive control system kits improve equipment performance to the degree that 3 or 4 typical third-class operators can accomplish the work of six men. Surveying time also is either minimized or not required. This reduction in personnel and equipment increases productivity by 35 percent, Ward said.

Motor Grader

The automatic system for the grader consists of two controls, one for blade elevation and the other for blade angle. Blade elevation control consists of a rotating laser beam transmitter, mounted on a post conveniently located to the work area, which establishes a reference plane (either horizontal or at any desired angle) and a receiver mounted on the grader which sets the blade elevation relative to the reference plane established by the laser beam. Ward said blade elevation accuracy has been tested to within ¼ inch for normal operation.

The transmitter uses a 12 volt battery for power and each transmitter can control approximately 70 acres or 2,000 feet diameter. The second system, also mounted on the grader, is an automatic blade angle control unit which uses the gravity vector as a reference to maintain the preset blade angle.

"The complete motor grader control system can be operated around the clock, day and night," Ward pointed out. "It has been proven to be simple to set up and operate. Elevation surveying is minimized, or not required, because the reference plane is set automatically by the rotating laser beam."

Automatic Scraper

The adaptive control installed on the scraper is an overspeed/underspeed switch-type governor which sets the blade elevation as a function of scraper velocity. For example, if the scraper blade encounters a stiffer resistance, the scraper velocity will decrease. In turn, the lower velocity activates the underspeed switch which elevates the blade, through the hydraulic control system, until the proper velocity, corresponding to optimum thrust, is achieved.

A similar but opposite sequence occurs when the scraper encounters light resistance and the blade is lowered. Velocity setting is adjustable in the control system to accommodate different soils and conditions. Thus the control "adapts" the blade elevation to the ground resistance encountered by the blade, optimizing the machine's earthmoving performance.

The blade governor will improve efficiency of the scraper, Ward said. Its rapid and positive response also would protect equipment from unexpected overload such as a buried boulder.

Bulldozer Automatic Blade Control

The bulldozer utilizes an adaptive control unit which maintains optimum

For The Seabee Bulldozer

Civil Engineering Laboratory Explores Potentials Of Automated Earth Moving Equipment

thrust by governing the machine's velocity with blade elevation control when the engine throttle is fixed. The bottom edge of the blade also is automatically maintained horizontal, or at a preset angle, by an automatic blade angle control unit similar to the one developed for the motor grader.

Once a surface is reasonably level, an additional control is activated. It is a laser automatic blade elevation device similar to the system on the motor grader. The result is a single machine capable of performing heavy, rough tasks normal for bulldozers and capable of producing high accuracy "finish" jobs that usually require a motor grader with a highly skilled operator.

Ward points out that the system can work day and night with relatively inexperienced operators at the control without significantly effecting job efficiency.

Laser Construction Surveyor

The basic instrument component is a standard laser distance geodimeter. Ward said it will be modified to also read lateral angle and convert the cylindrical coordinates (distance and angle) into cartesian coordinates using readly available integrated circuitry, a type commonly found in desk calculators. The engineer added that modifications will include a rotating prism to redirect the modulated laser so it sweeps horizontally to form an elevation reference plane and also be capable of simultaneously controlling the laser-equipped machinery while surveying, day or night.

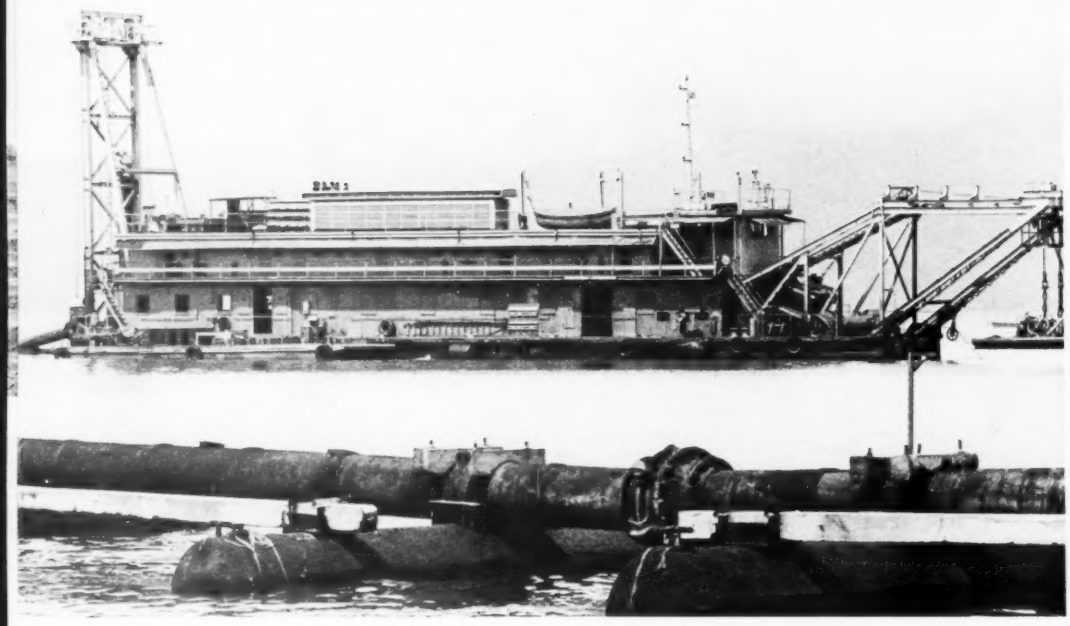
Ward said it is important to remember that the various automatic/adaptive controls being developed by CEL use identical open loop hydraulics. "In fact, flow rates, pressure drops, power and type of hydraulic oil are similar," he explained. "As a result, the same solenoid valves and fittings can be used in most cases for all control systems. It is expected that most of the electronic hardware also will be interchangeable. They are not all identical because of different requirements but the variations are principally in the field of electrical sensors (blade angle, laser receiver, velocity, etc.).

To assure orderly development of a practical, cost effective automatic/adaptive control system kit, the laboratory is planning a three-phase program. First, designs for the experimental systems will be examined and compared to existing test data as well as characteristics of various types and models of equipment to which the ultimate control kit will be applied. Ward said this procedure will define the minimum system requirements consistent with maximum component interchangeability.

Secondly, a contract schedule based on these minimum requirements will be prepared. One or more contracts will then be awarded for development of a complete set of component modules with which various control systems can be assembled. Modules will be installed on appropriate equipments and extensively evaluated.

Finally, modifications based on performance or cost will be made, followed by intensive in-service evaluations.

THE RESULT OF ONE pass by a bulldozer using the automatic blade angle and elevation control system. The laser transmitter (elevation reference) is mounted on a tripod in the foreground. Like the transmitter, the mask receiver, angle sensor and control box used on the bulldozer are the same instrumentations adapted to the motor grader.



By R. E. ECLEVIA
Public Works Center

• Subic Bay RolP

There's no doubt about it. *YM22 Norfolk* is an old lady. She seems to be in the retirement age, but she's much too important for housekeeping chores — the dredgery (sic) others avoid.

The *Norfolk* is a diesel electric dredge built in 1925 by a company that has long since disappeared from the industrial scene. Except for some modifications to keep her up with modern techniques, she retains most of her original features. The dredge is equipped with six 450 horsepower engines, two 750 horsepower engines and one 1,800 horsepower motor.

The dredge captain, Henry Mueller, says that for her power needs the dredge can generate 2,800 kilowatts, more than enough to light all street lamps on this Naval base. Like most old ladies she is self-sufficient. She has on board electrical and machinery shops for her own repairs and living quarters and galley for the crew.

The *Norfolk* has on several occasions taken to the open sea to Guam and Midway Island for dredging operaitons. Most of the time she remains in Subic Bay doing routine chores. Now she's digging up the bay, and the long line of pipes leading from the bay and running along the road indicates the activity going on.

The dredging program, known as M5-73 around Public Works Center, the command responsible for all dredging projects on base, has two distinct objectives, flood control and navigational safety. The program began in August last year and is expected to cost around $2 million upon completion scheduled for December 1975.

Dredging has been completed on the Kalaklan River mouth, the POL pier and approach, and the marine terminal. At present all activity centers on the uplift area between marine terminal and fuel piers, so called because of the worsening sedimentation condition and thick coral growth at the bottom.

Also scheduled for dredging are Leyte Wharf, drainage channel and portion of Kalaklan River, and other wharf areas of the Subic vicinity.

The uplift area, which was last dredged in 1971, has become so shallow that soundings register a depth of just 35 feet in many places. Ships require at least 50 feet depth to maneuver safely in and out of the harbor.

Capt. Mueller, who heads the 40-man, all-Filipino crew, explains that in ideal conditions the dredge can excavate up to 1,000 cubic yards of materials per hour. The dredge does the trick by having her rotating five-feet-diameter cutterhead break the solid materials to pieces. A suction pipe attached to the cutterhead pumps in the broken mass and then forces it through the discharge pipe and into the designated spoil area.

In the present situation, however, the dredge can approximate only half of its maximum capability because of the abnormal coral accretion. The broken coral also must pass through more than a mile of discharge pipe which contributes to the difficulty of operation.

"We have already removed some 500,000 cubic yards of materials from the uplift area," Mueller said. "We still have some 200,000 cubic yards to go and then we can move on to our next target," the Captain concluded.

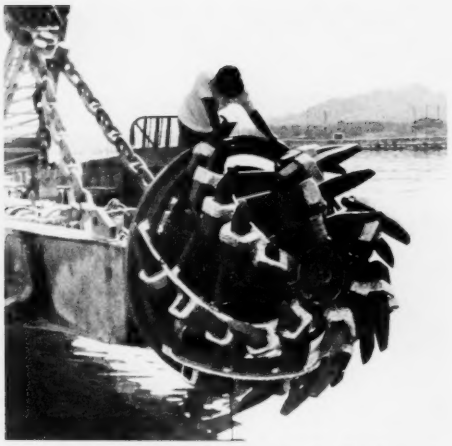
In all dredging operations the spoil area must be selected and prepared first, which is a major undertaking in itself. For the current project a dike was built around a mangrove swamp to sustain the materials coming in from the bay. The area was also provided with a convenient outlet to enable the water to flow back unhampered into the sea.

One significant objective of the pro-

LEVERMAN Rodolfo Gloria operates the control of Dredge Norfolk.

The Dredge Norfolk

...and its big bite



THE CUTTERHEAD, which breaks the hard coral mass at the bay's bottom, seems to threaten an inspecting crewmember.

gram is to reclaim swamp lands for future base expansion. The newly filled lagoon along Argonaut Highway is a typical example. The place is now a veritable terra firma that will support any structure.

During a recent inspection sortie, Ed Saxe, director of dredging process plants and ground structures branch of the Subic Public Works Center observed that filling the spoil area by truck will cost $2 per cubic yard.

"Since this holds some 300,000 cubic yards," Saxe said, "we estimate we save a total of $600,000. Also the hard coral and fine beach sands being dumped in make the best fill materials available."

Capt. Joseph A. D'Emidio, commanding officer of the Public Works Center; Art Spinney, head of the maintenance department, and Raphael Crawford, director of general services division, oversee the program. Three supervisors are responsible for the smooth operation of the dredge. They are Wilfredo Ebalo, Dominador Santos and Pacifico Torres.

The program is well ahead of schedule, but the job is of such magnitude that it is still not halfway completed. Nor is it anticipated for completion this year because of seasonal weather conditions.

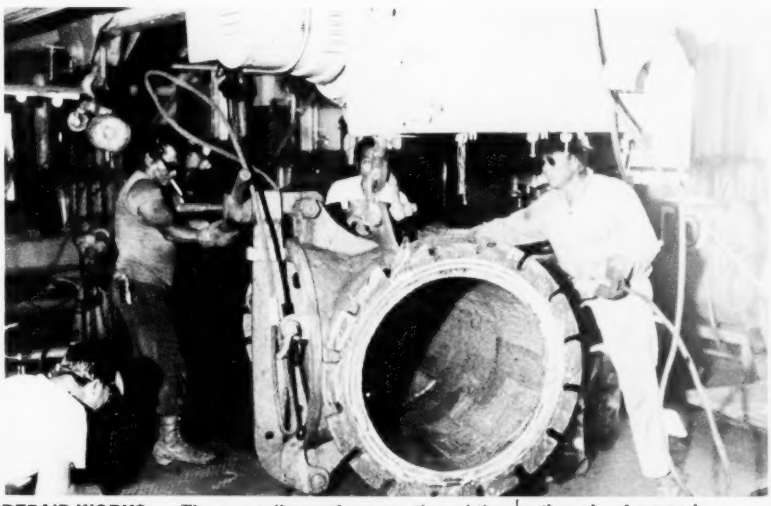
In order to accelerate the pace, PWC hopes that another dredge, the *YM38 Seabee*, which is at present undergoing repairs after its recent arrival from Vietnam, will join the *Norfolk* in the operation. The *Seabee*, although somewhat smaller and therefore of lesser capability than the *Norfolk*, is the more modern of the two. It was built in 1950 in Baltimore, Md.

The *Seabee*, which has only two engines to drive the main pump and one auxiliary engine for the hydraulic pump, requires fewer operational personnel. And with her modern cutterhead and powerful suction pipe, the *Seabee* will be a welcome addition.

It doesn't mean, however, that the *Norfolk* will be overshadowed by the younger and trimmer newcomer.

The gray and bulky old lady has still a lot of grind!

DREDGE CAPTAIN Henry Mueller plots position of the Norfolk.



REPAIR WORKS — The crew dismantles a portion of the suction pipe for repair. There are few maintenance jobs that the crew cannot perform.

NOTES and EDITOR'S COMMENTS

• LAST ISSUE we requested readers' assistance in locating certain back issues of the *Engineering News-Record* and *Armed Forces Journal* to complete the periodical files for the library of CECOS (Naval School, Civil Engineering Corps, Officers). We have great faith in our readers, which once again was justified by a prompt and magnificent response from *Christopher J. Foster, Inc.*, of Port Washington, N.Y., whose principal *C. J. Foster, jr.*, and his secretary, *Edith Graham*, supplied the majority of the missing copies, posthaste. And, also responding with equal enthusiasm was *LCDR Myron B. Sherman, CEC, USN* of the *OICC office NAVFAC Contracts*, Madrid, Spain. On behalf of CECOS, we extend many thanks.

Now, at the risk of being presumptuous of the readers good will, does anyone have the following: the September 1971 edition of the *Armed Forces Journal;* the February 1973 issue of *Naval Institute Proceedings;* the August 1971 edition of *Civil Engineering* and the editions of *Engineering News-Record* dated January 13, 1972; February 22, May 24 and June 28 of 1973? If so, please contact Mrs. Barbara Horn, Librarian, CECOS, Port Hueneme, Calif. 93043 or call Autovon 360-5655 or commercial collect (805) 982-3104. If persons having these copies are not within governmental circles please call so that a postage pre-paid label can be forwarded. Again, many thanks from CECOS!

• AUTHOR JAMES HILTON'S Brookfield Academy had its *Mr. Chips*, and so the Civil Engineer Corps, Officers School (CECOS) has its *Ted Murphy*. Readers may recall an article authored by him, "The Young Officer, 1972". Now, he's at it again with thought-provoking views concerning articles, books, essays and opinions that normally escape a reader's (or editor's for that matter) attention. The inaugural column by TCM appears on page 41, this edition.

• AND NOW TO TWO INTERESTING LETTERS:

Dear Sir:

The article, "Is there Man or Beast in Maintenance Management?" appearing in the Summer 1974 issue of the "Navy Civil Engineer" is surprising since it suggests that maintenance management impediments have been imposed upon the activity manager by higher authority.

As an industrial engineer with experience in both government and industry, I am continually surprised as to the number of activity managers who either failed to read or make an effort to understand the basis of the Navy's Maintenance Management System as described in NAVFAC MO-321, entitled *Maintenance Management of Public Works and Public Utilities*. The publication develops a logical framework towards achieving effective maintenance management. However, there is no guide or system which can attain desired objectives unless its participants are governed by similar goals. In the words of MO-321, "All line supervisors must accept this responsibility if maximum efficiency of work performance is to be achieved. Responsibility for planning, executing, and appraisal is an integral part of every supervisor's duties."

None of the reports suggested by MO-321 are forwarded to higher authority. They are recommended for internal use as long as they serve their intended purpose. Is it not a sign of good management to know what has been accomplished, what has been the planned and actual performance and why we might have failed to meet our plan?

Wherever the management impediments exist which the article highlights, may I reccommend that MO-321 be consulted. My colleagues in industry are studying the volume and a good many of them are adapting its principles for their companies' use and profit.

Obviously, the current maintenance management system does not solve all "ills", but I do not believe that the Navy can afford the alternative which might prove to be utter chaos. The author appears to use individual problem areas which he has encountered and draw general conclusions pertaining to the total system.

Mr. Hall quotes Dr. E. S. Jones as saying ". . . we must look into the past as in a mirror while we forge ahead into the present and the future. To glance at the past to learn its lessons in wisdom."

May I suggest that before we "forge ahead", we ". . . glance at the past to learn its lessons . . ." and make a reasonable effort to understand the existing system of Maintenance Management.

Sincerely yours,
Harry L. Newman
Industrial Engineer
Northern Division, NAVFAC
Philadelphia, PA 19112

Dear Sir:

The summer 1974 edition of the NAVY CIVIL ENGINEER was a very fine piece of work. It is undoubtedly one of the best of what have recently been well written, tightly edited issues of the magazine. Particularly impressive was the way a wide variety of items — running the gamut from short news notes to thought-provoking short professional papers — were integrated into one coherent, interesting issue.

I found particularly interesting Mr. Hall's article "Is There Man or Beast In Maintenance Management?". He made a number of pertinent points which were all the more convincing for being based on actual experiences.

Keep it up!

Cordially,
D. J. McAuley
Lt, CEC, USNR

The Navy Civil Engineer welcomes comments and opinions, in fact, "equal time" of rebuttal to Mr. Hall's article of apparent diversified reaction has been given to *Bernard T. Lewis*, Head, Industrial Engineering Branch, HQNAVFAC in the next edition. — *The Editor.*

• LAST ISSUE contained an article concerning the construction design of an overseas homeport at Elefsis, Greece (p. 17 Summer 1974) which was co-authored by *CDR A. Kartalis*, CEC, USN, and *Charles D. Morrissey*. Mr. Morrissey was not properly identified. At the time of the authorship, he was *vice-president* of URS/Madigan-Praeger, Inc., New York City. Perhaps, the oversight was prophetic, as Mr. Morrissey is now *president* of the aforementioned firm. Congratulations to him and thanks for the contribution.

it makes good sense...

The Naval Reserve is currently undergoing a fundamental restructuring to provide for a Selected Reserve organized into mission oriented, task performing units which could be mobilized in whole or in part to meet contingency manpower requirements.

Under this restructuring, the Civil Engineer Corps/Seabee community will have two separate programs. One, of course, is the familiar Reserve Naval Construction Force (RNCF). This program is basically unaffected by the restructuring and has, in fact, proven to be part of the model for the restructuring process. The Commander, FIRST Reserve Naval Construction Brigade will continue to direct the RNCF toward maintaining its mission of being a supplementary construction force for the *active* Naval Construction Force (NCF) capable of rapid mobilization.

Our second program, the *Naval Reserve Facilities Engineering Program,* is a much needed Reserve component which will provide highly trained and motivated reservists to augment Headquarters, our Public Works Centers (PWCs), Engineering Field Divisions (EFDs) and Officer-in-Charge of Construction offices (OICCs). The program will be composed of units throughout the country, each of which has a designated activity to which the unit reports if recalled to active duty. The emphasis here is on units and not on individuals as has been the case in the past. Under this new concept, the units will receive task oriented training directly from their "parent" command and will, where feasible, perform two weeks active duty for training at that command.

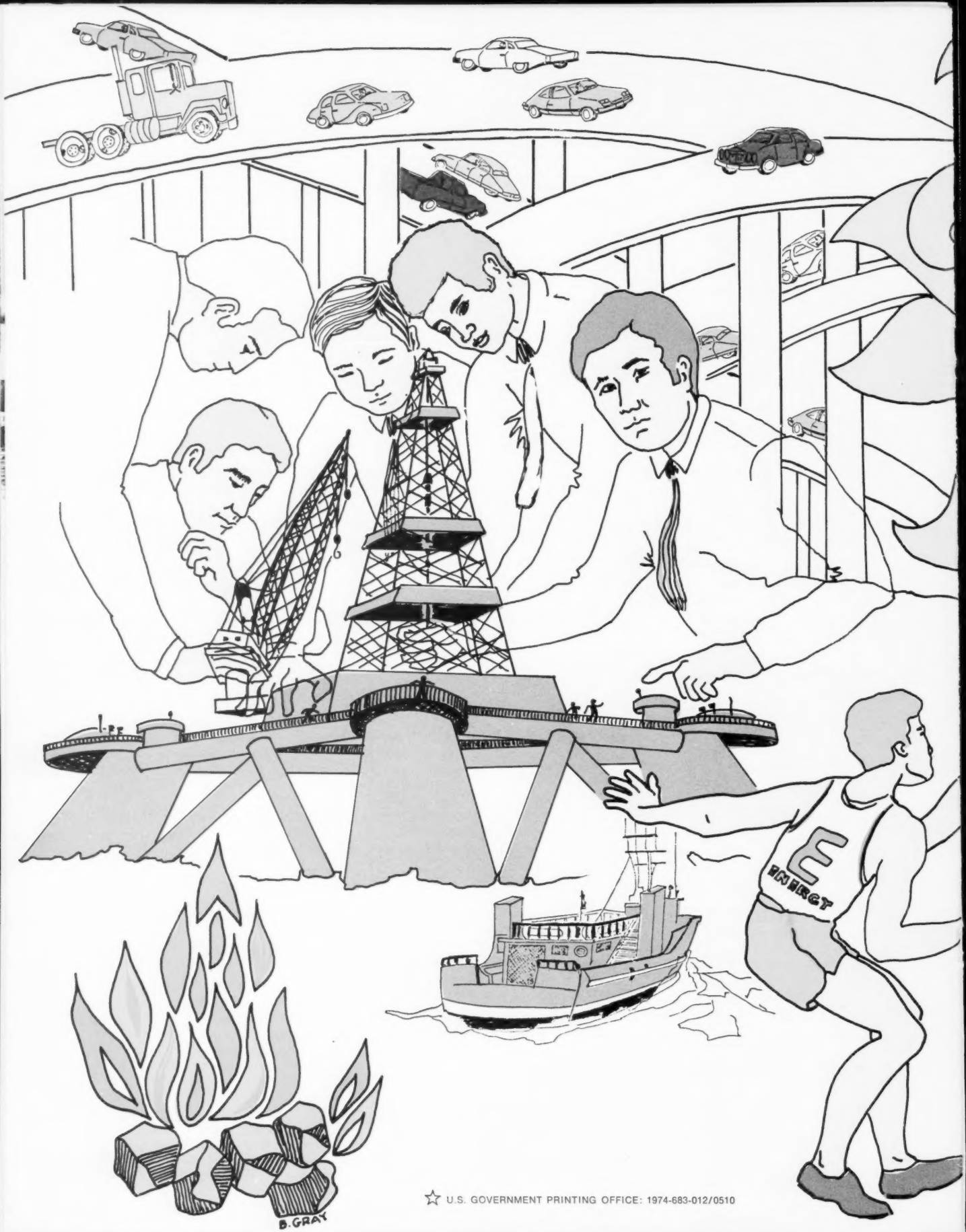
This program will provide the *Total Force Navy* with better trained and, hence, more highly qualified reservists. At the same time, the individual reservist will be able to provide a meaningful service to "his" command.

It makes good sense any way you look at it.

A. R. Marschall

A. R. MARSCHALL
Rear Admiral, CEC, USN
Chief of Civil Engineers
Commander, NAVFAC

Next issue, Admiral Marschall has invited a commentary from Rear Admiral Kenneth P. Sears, CEC, USN, Director of Construction Operations, Office of the Deputy Assistant Secretary of Defense For Installations and Housing.



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